PLUGGING IN

BUILDING NYC'S TECH EDUCATION & TRAINING ECOSYSTEM

ROBIN HOOD
LEARNING + TECHNOLOGY FUND
IN PARTNERSHIP WITH OVERDECK FAMILY FOUNDATION AND SIEGEL FAMILY ENDOWMENT

Google

Bloomberg

verizon✓

tech: nyc

Tech:NYC is an engaged network of tech leaders working to foster a dynamic, diverse, and creative New York. Tech:NYC brings together principled New Yorkers to support a successful technology ecosystem, attract and retain top-tier talent, and celebrate New York and the companies that call it home.

Center *for an* Urban Future

Center for an Urban Future (CUF) is a leading New York City–based think tank that generates smart and sustainable public policies to reduce inequality, increase economic mobility, and grow the economy.

Cover photo: Markus Spiske for Unsplash

CONTENTS

TO EXPLORE THIS REPORT'S ACCOMPANYING INTERACTIVE MAP PLEASE VISIT TECHSKILLS.NYC

K–12 PROGRAM PROFILES

ADULT PROGRAM PROFILES

PLUGGING IN: BUILDING NYC'S TECH EDUCATION AND TRAINING ECOSYSTEM

For New York City to succeed in elevating far more New Yorkers from lower-income backgrounds into the middle class, the city will need to make significantly more progress in expanding access to technology careers. Over the past decade, jobs in technology have been among the fastest-growing occupations in New York, and the tech sector has become the city's most reliable source of new well-paying jobs. But even as demand for tech talent grows, too few of those good jobs are going to New Yorkers from low-income communities.

This is no small problem for New York. The troubling opportunity gap that exists in the city's tech workforce is exacerbating inequalities across the five boroughs. It also threatens the economic competitiveness of the city's tech sector, which is already experiencing a talent shortage and will need to tap more of the local workforce to sustain its growth.

Tackling this will require change on multiple fronts: wholesale improvements in the city's education and workforce training systems; stronger commitments from employers to hire, train, and retain diverse local talent; and major new investments that expose New Yorkers to these careers, introduce them to foundational skills, and help them develop the specific competencies and hands-on experience that are in demand at tech companies today.

This report points the way forward, providing the first-ever comprehensive assessment—and map—of New York City's tech education and training ecosystem.

Our study, which takes a close look at both computing education programs focused on children in the K–12 system and adult-oriented tech workforce training programs, finds that the city's tech skills-building ecosystem has come a long way in recent years. There are now at least 238 tech education and training organizations operating 506 programs in 857 locations across the five boroughs, and that does not include the exciting work underway in city schools to deliver on Mayor de Blasio's commitment to offer computer science in every public school by 2025.

However, we also found striking geographic disparities, programming gaps, and capacity challenges, which limit access for underserved communities and make it more difficult to develop a diverse pipeline of talent for the tech sector. For instance, our analysis shows that tech skills-building programs are unevenly distributed across the city, with Manhattan home to significantly more programs than any other borough. We found that 11 percent of the city's Census-defined neighborhoods have just one program identified in our survey, or none at all.

There are also gaps in the types of programs being offered. The city has relatively few programs focused on children in grades K–5, a potential problem given growing evidence that early exposure to foundational STEM education can make a big difference in closing achievement gaps for low-income students and shaping early attitudes toward technology careers.[1] Similarly, not enough of the K–12 programs are focused on developing computational thinking skills, though researchers and tech employers say that introducing young people to core concepts of computational thinking is an essential building block for future success in tech fields.

Similar programming gaps exist on the adult side, with consequences for both job-seekers and tech employers in search of job-ready talent. Our analysis shows that more than three-quarters of tech training programs accessible to low-income adults around the city are focused on basic digital literacy or introductory computer skills, with only a small number of programs offering the sort of in-depth skills training that can lead to a tech job in relatively short order. Meanwhile, where the more in-depth skills-building programs do exist, they tend to serve at most a few dozen to a few hundred people per year—even as the city adds thousands of technology jobs. In addition, few programs connect from one skill level to another, making for a disjointed array of programs rather than a continuum.

There is much at stake for New York to address these challenges and build on recent successes. Expanding access to tech careers is one of the city's best opportunities to reduce inequality and expand pathways out of poverty. At the same time, the tech sector has become a major new engine of the city's growth, and companies throughout the sector are hungry for more skilled workers. To realize this enormous opportunity, city leaders should take decisive action to foster a stronger skills-building ecosystem that can prepare thousands more New Yorkers for the jobs of the future.

This report—and accompanying map—provides a new level of detail about the educational and workforce training infrastructure that currently exists in New York City to help New Yorkers develop the range of skills needed to access technology careers, and assesses how well these programs are aligned with the tech sector's evolving workforce needs. Researched and written by the Center for an Urban Future in partnership with Tech:NYC—and generously supported by the Robin Hood Learning + Technology Fund, Google, Bloomberg, and Verizon—the report draws from more than 130 interviews with tech executives, skills-building program directors, educators, city officials, nonprofit leaders, researchers, and philanthropic funders.

The centerpiece of the report is a series of 70 profiles of skills-building organizations focused on both students in grades K–12 and working adults, which provides a deeper dive into many of the key organizations teaching a range of tech skills to New Yorkers of all ages.

One of the clear takeaways from our research is that the fast-growing technology sector represents a golden opportunity for New Yorkers from low-income backgrounds to springboard into the middle class, but that a significant disconnect exists: tech companies are hungry for skilled workers and increasingly eager to hire locally, but the city's current skills-building ecosystem is not yet up to the task. New York today provides insufficient access to high quality educational and training opportunities in technology for many residents from low-income communities. The result is that too few New Yorkers gain the hands-on skills training, educational experiences and credentials, and professional networks needed to spark successful careers in tech.

The shortcomings of New York City's tech talent development infrastructure are beginning to affect the city's tech sector. Over the coming decade, New York City is projected to add tens of thousands of new jobs in tech fields, most of which will pay salaries well above the median. But company leaders say that growth could be at risk unless New York's tech companies are able to access a larger pool of well-prepared local talent. Indeed, according to a 2018 survey of New York City's tech companies conducted by Tech:NYC and Accenture, 83 percent of tech companies planned to increase tech hiring in the year ahead, but just 50 percent said they were confident in finding the talent they need locally and nearly half said they will not be able to innovate at the same pace if they can't find the talent they need.[2]

Some of those talent needs are being met by New York City's higher education institutions. Columbia University, New York University (NYU) Tandon School of Engineering, Cornell Tech, and the City University of New York (CUNY) are all producing highly skilled and qualified STEM graduates in increasing numbers. But meeting the growing demand for local tech talent among New York City employers—while also seizing the opportunity to lift far more New Yorkers into the middle class by expanding access to careers in technology—will require a more comprehensive, cradle-to-career approach to sparking interest in technology and cultivating computing skills.

To better understand the strengths and gaps in that system today, this report examines the full landscape of skills-building and exploration programs available to young New Yorkers in grades K–12, as well as the tech training programs aimed at working adults. Our research finds that while this skills-building ecosystem is larger and more robust than ever, significant gaps and challenges remain—with consequences for the intersecting goals of diversifying hiring in the fast-growing tech sector and greatly expanding economic mobility for New Yorkers from low-income communities.

New York City's tech skills-building ecosystem is larger and more robust than ever.

New York City is home to hundreds of programs across a range of tech skills, from coding camps and robotics classes for children and teens to workforce training programs in IT support and bootcamps focused on software engineering or data science. For children and young adults in grades K–12, our research examined in-school programs operated by nonprofit organizations, after-school programs, summer programs, and programs provided by libraries, museums, colleges and universities, and other civic institutions. For working adults, our research focused on programs that are broadly accessible to New Yorkers from low-income backgrounds, including programs that are free; programs with a deferred tuition model; and programs that offer scholarships and need-based funding opportunities.

Our research finds that New York City's existing skills-building landscape is diverse and more extensive than is generally understood. We identified 113 organizations offering at least 132 unique programs in the K–12 space across 385 specific locations, as well as at least 125 organizations offering unique programs aimed at working adults across 472 specific locations.

Based on comprehensive interviews with more than 70 of these organizations and an analysis of program data, we estimate that the programs aimed at grades K–12 are serving tens of thousands of students each year, while the in-depth, career-oriented programs aimed at working adults are serving just a few thousand participants annually. At the same time, there are more than 330,000 people working in tech jobs across the New York City region today, and tens of thousands more jobs are projected to be added in the coming decade.[3] As a result, the city's skill-building ecosystem for tech careers is still notably small relative to the scale of opportunities in the sector today and in the future.

City-Led Initiatives to Develop Underrepresented Tech Talent

New York City's technology skills-building infrastructure includes several important recent initiatives. Launched in 2015, Computer Science for All (CS4AllNYC) is a ten-year, public-private partnership led by the NYC Department of Education (DOE), the Fund for Public Schools, and the Mayor's Office to deliver computer science education to all of the city's approximately 1.1 million public school students, with a focus on female, Black, and Latinx students. CS4AllNYC is currently ongoing in more than 700 K–12 schools, and 14 percent of all K–12 students citywide were enrolled in CS4All classes in 2017–18.

The Department of Youth & Community Development (DYCD) provides students in grades three through eight with experiential STEM opportunities after school through the following program models: Comprehensive After School System of New York City (COMPASS), School's Out NYC (SONYC), Cornerstone (at NYCHA Community Centers) and Beacon (school-based community centers for families). DYCD also administers the NYC Center for Youth Employment (CYE), a public-private effort begun in 2015 to expand work experience opportunities for high school and college students ages 16 to 22.

Launched in 2014, the Tech Talent Pipeline (TTP) works to develop local tech talent in partnership with New York City tech employers. TTP works with about 400 companies to recruit and train underrepresented talent, shape curricula and review RFPs, and develop training programs in fields like web development, data analysis, and software engineering.

Tech skills-building programs are unevenly distributed across the city, and several neighborhoods have very few, if any, relevant programs.

Although New York City benefits from hundreds of tech and STEM skills-building programs and initiatives, our research finds that these programs are highly concentrated in certain parts of the city, leaving many neighborhoods relatively underserved. Manhattan is home to significantly more K–12 and adult tech skills-building programs than any other borough, despite containing just 19 percent of the city's population. Out of the city's 55 Census-defined neighborhoods, 17 contain 15 or more program locations. But six of the 55 neighborhoods (11 percent) have just one program or none at all that our research could identify. Although it's understandable that programs are highly concentrated in Manhattan—near major employers and accessible to public transit—these widespread gaps make it harder for many New Yorkers from lower-income communities to access tech skills-building programs, and limit the pipeline into tech employment. These geographic gaps highlight parts of the city where physical access to tech skills-building is limited, while also pointing to underlying socioeconomic factors that shape broader patterns around access to opportunity.

- The neighborhoods with the highest concentration of K–12 programs are in Manhattan and downtown Brooklyn. Midtown/Chelsea has 18 programs in 32 locations (the most in any Census-defined neighborhood), Greenwich Village/Soho/Battery Park City has 27 programs in 34 locations. Park Slope/Carroll Gardens/Red Hook has 20 programs in 28 locations.

- All but one Census-defined neighborhood in Manhattan has at least 11 K–12 program locations (the exception is Washington Heights/Inwood, which has seven).

- In eight Census-defined neighborhoods, our research was unable to identify any specific K–12 programs: Jackson Heights/North Corona, Flushing/Murray Hill/Whitestone, Bayside/Douglaston/Little Neck, and Howard Beach/Ozone Park in Queens; Bensonhurst/Bath Beach and Sheepshead Bay/Gerritsen Beach/Homecrest in Brooklyn; Pelham Parkway/Morris Park in the Bronx, and Tottenville/Great Kills/Annadale in Staten Island.

- There are four Census-defined neighborhoods where we were unable to identify any adult tech training programs: Wakefield, Williamsbridge & Woodlawn in the Bronx; Tottenville, Great Kills & Annadale in Staten Island; Ridgewood, Glendale, & Middle Village in Queens; and Howard Beach & Ozone Park in Queens.

- In-depth adult programs are highly concentrated in Manhattan and Brooklyn. These programs operate at 96 locations in Manhattan, 35 locations in Brooklyn, and 29 locations in Queens, ten locations in the Bronx, and none on Staten Island.

K–12 Tech Skills Program Locations by Community District
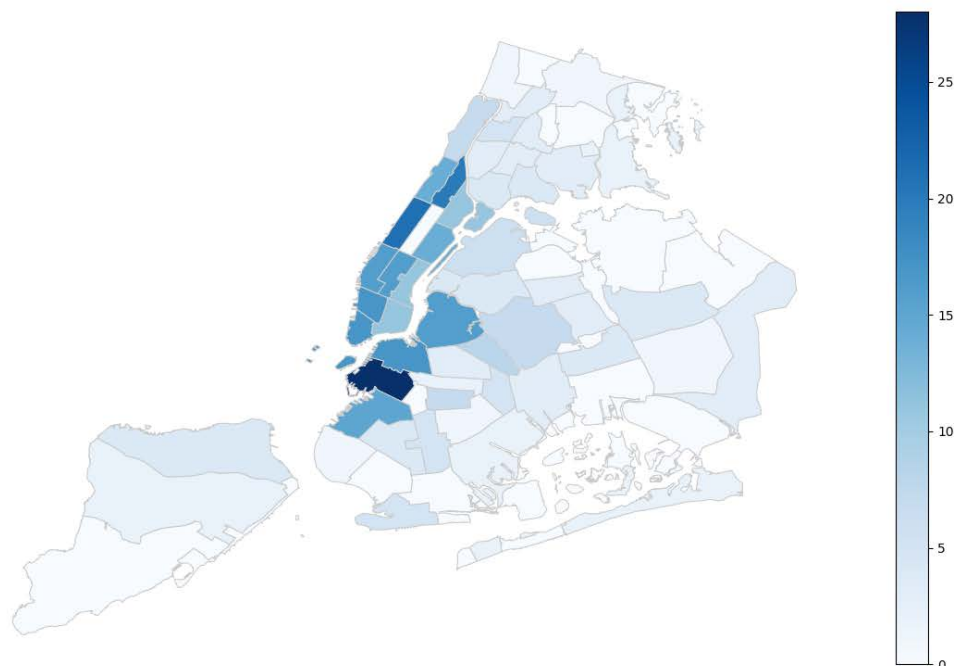
Source: Data gathered by the Center for an Urban Future between March and October of 2019.

Role of libraries in expanding access to tech skills

- In many city neighborhoods, libraries play an outsized role in providing access to tech skills training. Across the 15 New York City neighborhoods with the highest number of tech skills-building programs, libraries account for 5 percent of total program locations.

- But across the 15 neighborhoods with the lowest number of tech skills-building programs, libraries account for 27 percent of total program locations.

New York has fewer tech skills-building and STEM exploration programs focused on grades K–5.

Across more than 40 interviews with experts and program managers focused on K–12 tech skills-building initiatives, we heard consistently that early intervention is essential to help increase the share of underrepresented students who pursue further opportunities in STEM. But we found relatively few computing and STEM skills-building and exploration programs designed to reach students before middle school. Citywide, many STEM programs aimed at grades K–12 identified for this report tend to focus on older students and afterschool programs, limiting the diversity and inclusivity of the STEM pipeline by emphasizing more self-selecting opportunities. This exacerbates the city's pipeline problem, as earlier exposure is likely to have the most powerful effect on encouraging students underrepresented in STEM to pursue computing education and STEM subjects in middle school and beyond.

Our research identified a wide range of free tech skills-building programs aimed at young New Yorkers in the K–12 system, both in-school and out-of-school, ranging from coding classes and environmental science camps to robotics workshops and online curricula for teachers. But across the full landscape of K–12 program locations, we found that fewer than one in three programs is focused specifically on students in grades K–5.

- Our analysis finds that more than 67 percent of current K–12 STEM program locations are focused specifically on students in middle school and high school, while just 33 percent are focused specifically on grades K–5.

- The programs focused specifically on K–5 students are highly concentrated in just a few neighborhoods. Our analysis finds that there are seven such programs in Park Slope/Carroll Gardens/Red Hook, six such programs on the West Side/Upper West Side of Manhattan, four such programs in Brooklyn Heights/Fort Greene, and four such programs in Chelsea/Midtown, giving each of these neighborhoods

more K–5 programs than Staten Island and the Bronx combined. By comparison, Park Slope/Carroll Gardens/Red Hook is home to fewer than 7,000 students ages five to nine, while the Bronx is home to more than 101,000.

Among NYC's STEM-focused K–12 programs, a relatively small share are focusing on computational thinking—including just a handful targeted at grades K–5.

While many of the K–12 programs identified in our research integrate computing concepts into their curricula, relatively few have a specific focus on computational thinking skills. The comparatively low number of programs citywide focused on cultivating the full range of computational thinking skills—from decomposition and abstraction to pattern matching and algorithm design—presents a challenge for New York. According to interviews with program directors and educators focused on building foundational tech and computing skills among younger children, there is a growing need for programs that help introduce the core concepts of computational thinking long before

children are ever exposed to a coding language—or even a computer screen.

At the same time, interviews with multiple tech company leaders found a growing need for computational thinking skills across all levels of tech sector employment. In order to help students develop the flexible, creative problem-solving abilities that companies are seeking, educational systems will need to prioritize computational learning long before students are exposed to specific programming languages or computer science concepts. Computational thinking can serve as an important on-ramp to computer science: it is broadly accessible to students at young ages, can be widely adopted with existing resources, and can ensure broader exposure to the foundational logic underlying every other tech skill. But these sorts of programs are still in short supply in New York City today, especially among grades K–5, and there is a lack of consensus on what should comprise the required curriculum. Integrating computational thinking into every elementary school could greatly expand on-ramps into further computing education and help plug leaks in the STEM education pipeline.

Geography of NYC's K–12 Tech and STEM Skills-Building Programs
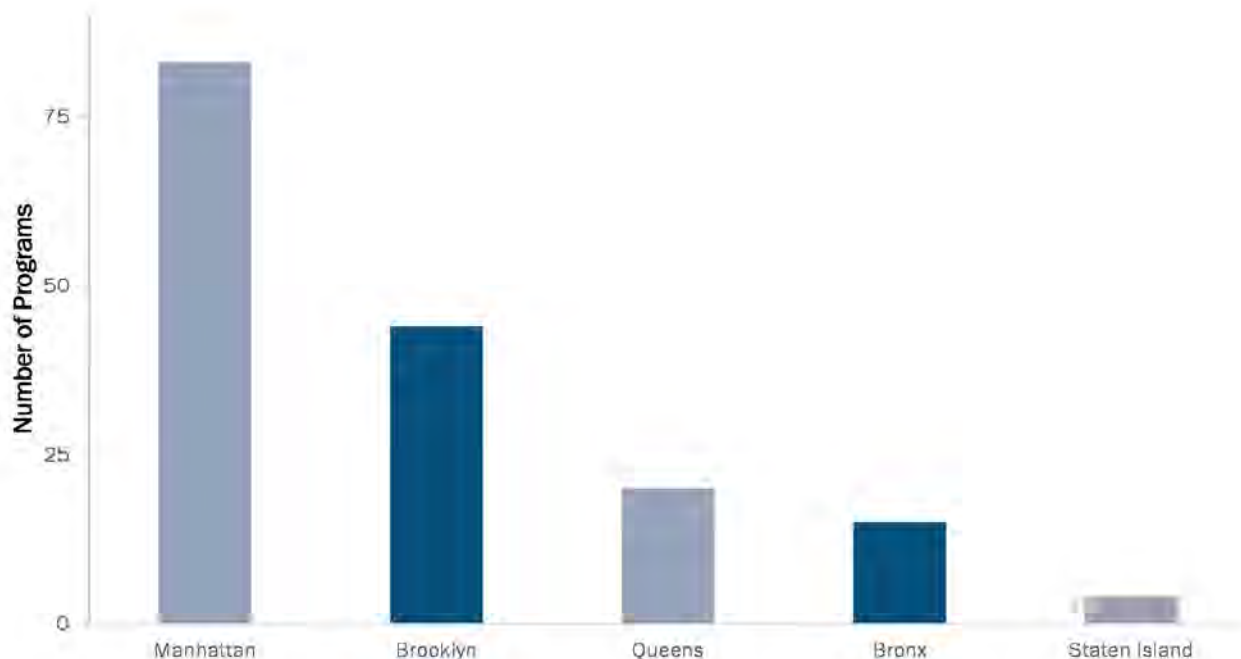
Source: Data gathered by the Center for an Urban Future between March and October of 2019.

- Our research identified 26 of 132 programs with a specific focus on computational thinking skills (20 percent). These 26 programs are available across 129 locations

- Of these, the majority of these program locations are serving students of high-school age (the total share is greater than 100 as some programs serve multiple age ranges):
    - 78 serve 9–12 students (61 percent)
    - 51 serve K–5 students (40 percent)
    - 30 serve 6–8 students (23 percent)

- Our analysis finds that there are 14 programs with a core focus on computational thinking at 52 locations in Manhattan and 14 programs at 56 locations in Brooklyn. Our research was only able to identify seven programs with a core focus on computational thinking in Queens, three in the Bronx, and one on Staten Island.

Computational thinking reflects the ability to break down a larger problem into its constituent parts, logically organize data for analysis, observe and represent patterns and trends through abstractions like models and simulations, assess the underlying logic that generates these patterns, arrange the steps required to solve that problem in a sequence, and evaluate the results. This way of thinking is at the core of scientific hypotheses and experiments, underscores the structure of both natural language and programming languages, and guides processes ranging from identifying patterns and diagnosing problems to designing an object or choreographing a dance. Unlike learning a specific programming language, for instance, computational thinking offers a framework for exploring complex, open-ended problems in a logical way that is applicable across math, science, and the humanities—and these lessons can be integrated into the regular school day.

"We know that students are going to face situations where they will want to build digital solutions to problems, or at least to understand how the digital solutions work," says Diane Levitt, senior director of K–12 education for Cornell Tech. "Embedding computational thinking in early education can help put those tools in kids' hands."

Few of the city's nonprofit adult tech workforce training programs are focused on in-depth training for tech careers, and only a handful are training for engineering roles.

For adult New Yorkers seeking a skills boost to help prepare for jobs in technology, New York City is home to a range of workforce training and skills-building programs focused on tech and digital skills. In a city with nearly 3.4 million residents over age 25 who lack a college credential, these programs provide an essential source of training and help build ladders into occupations with better wages and greater opportunities for career advancement.[4] But our research finds that relatively few of the city's workforce skills-building programs accessible to lower-income adults are providing the sort of in-depth, career-oriented training that can bridge into tech careers, and just a handful are training New Yorkers for software engineering roles.

NYC's Free & Non-Profit Adult Program-Locations

24

222

Source: Data gathered by the Center for an Urban Future between March and October of 2019

■ Basic, Intro, & Entry-level   ■ Mid-level & Advanced
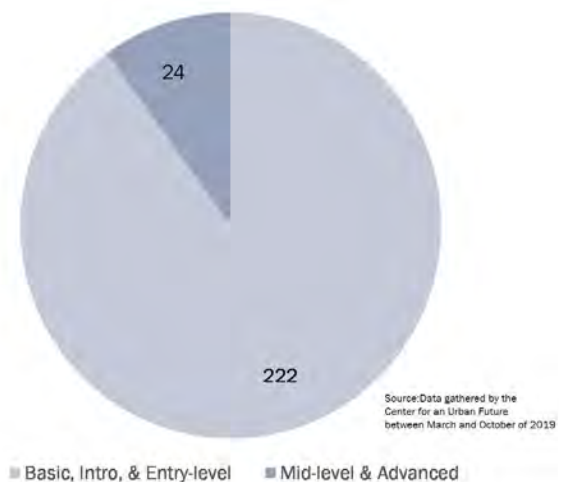
- Among free and nonprofit workforce training programs, our research identified just 7 programs out of 158 citywide that offer in-depth, advanced training for coding jobs. By comparison, 80 of 158 programs focus on teaching basic computer skills and digital literacy and 141 of 158 programs focus on basic computer skills, intro-level skills, or entry-level skills. Just 3 percent of program locations teach advanced skills.

- Among free and nonprofit programs, 77 percent of all program locations teach either basic or intro-level skills. In total, 90 percent of program locations teach basic, intro, or entry-level skills.

- Including the full landscape of training providers—which includes nonprofit programs, as well as low-cost for-profit

K–5 Focused Tech Skills Program Locations by Community District
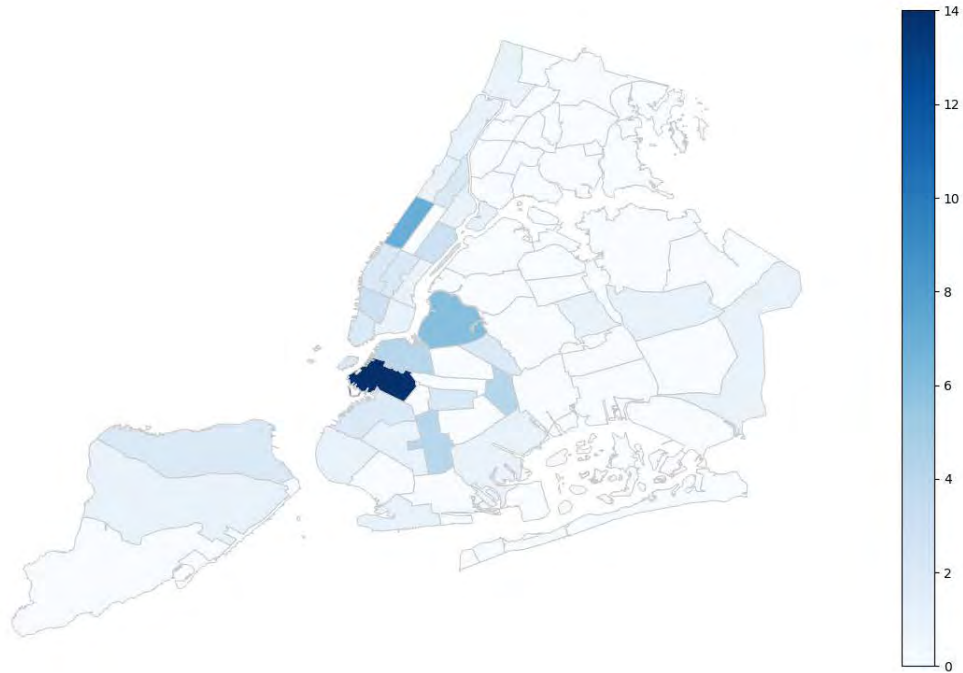
Source: Data gathered by the Center for an Urban Future between March and October of 2019.

Adult Tech Skills Program Locations by Community District
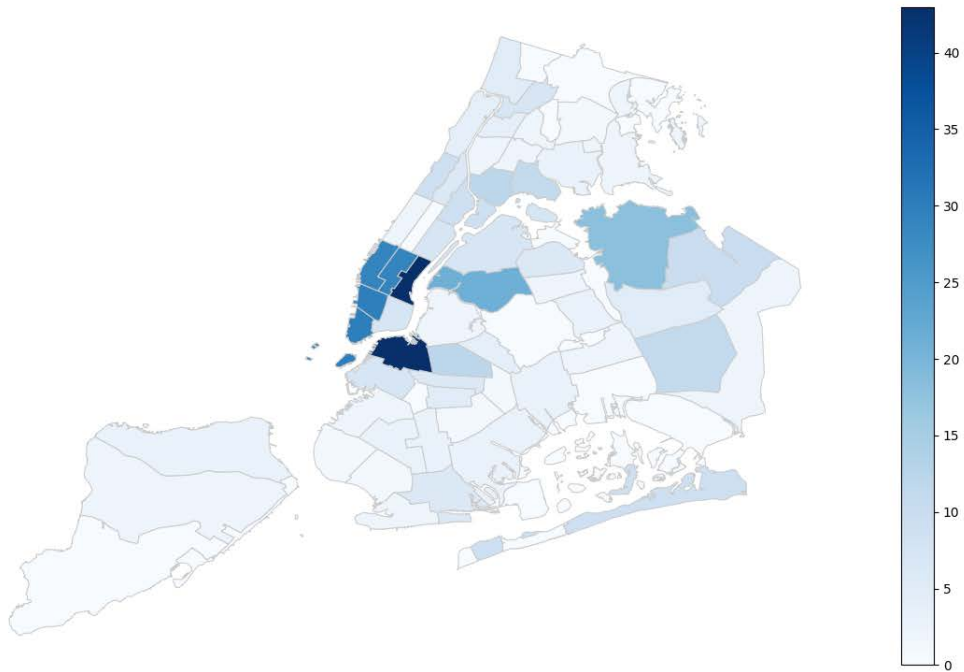
Source: Data gathered by the Center for an Urban Future between March and October of 2019.

Geography of NYC's Adult Tech Skills-Building Programs
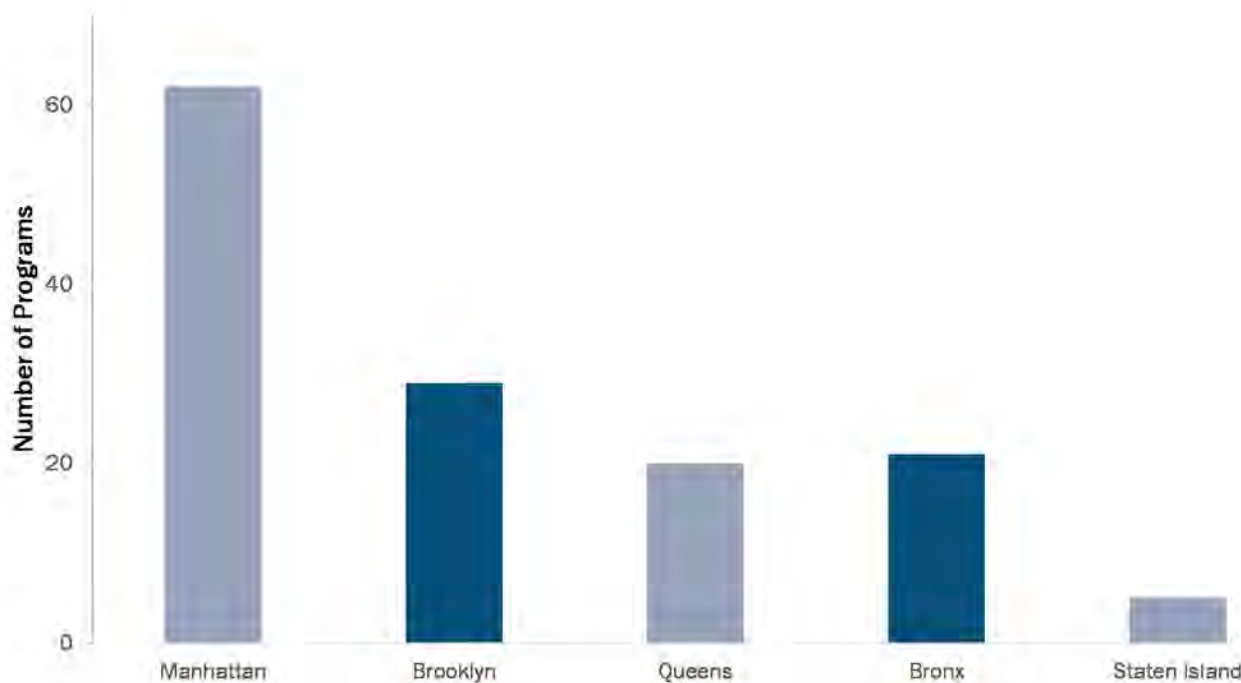
Source: Data gathered by the Center for an Urban Future between March and October of 2019.

training schools, CUNY continuing education programs, and for-profit bootcamps with scholarship opportunities and/or deferred tuition options—the share of in-depth programs is only slightly larger. Out of the 374 adult training programs overall, 101 focus on teaching basic computer skills and digital literacy. In total, 305 programs focus on basic computer skills, intro-level skills, or entry-level skills. Just 29 programs train New Yorkers for careers requiring advanced coding or engineering skills, and 40 provide career-oriented training for mid-level jobs in tech.

- Our analysis finds that there are no in-depth training programs currently operating in the Bronx or Staten Island with a focus on advanced-level tech careers. Only five programs offer mid-level tech skills training in these two boroughs (while Manhattan is home to 20 advanced programs and 28 mid-level programs).

- In addition, CUNY offers 112 adult continuing education training programs. Among these programs, 19 percent teach basic computer skills, 65 percent offer intro-level skills training, 15 percent teach entry-level, career-oriented skills, and 2 percent provide mid-level skills training.

Many adult-focused tech training programs say that preexisting skills deficits—including low literacy levels, math skills, and comfort with technology—pose barriers to aspiring participants.

Our research finds that several factors contribute to the relatively low number of adult-focused free and low-cost programs that offer in-depth training for technology careers, including the high cost of providing intensive instruction by industry professionals and the challenge of developing technical curricula with significant input from employers. But for many of the in-depth, career-oriented training programs that exist today, organizers say that too few working New York adults are prepared to succeed in their programs. Multiple program managers at the city's adult-focused tech skills-building providers—specifically those oriented toward careers in tech—told our researchers that a large share of aspiring participants are turned away due to a lack of basic literacy, numeracy, and/or digital skills, or because applicants lack a high school diploma.

These fundamental barriers to tech skills-building and training exist across all five boroughs, but are particularly severe in many low-income communities of color, including predominantly immigrant communities. For instance, while just

In-Depth Adult Tech Skills Program Locations by Community District
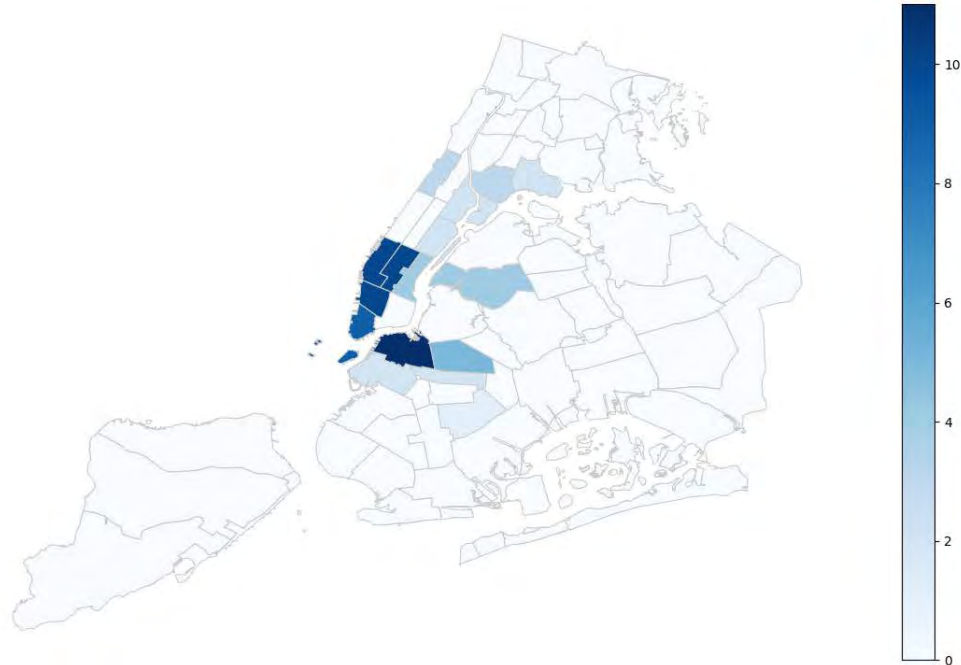
Source: Data gathered by the Center for an Urban Future between March and October of 2019.

13 percent of adults in Manhattan did not graduate from high school, the same is true for 34 percent of adults in the South Bronx and 40 percent of adults in Sunset Park. In total, more than 1.1 million adults in New York City lack a high school diploma, over 1.8 million adults in New York City speak English less than very well, more than 707,000 New York City households lack access to broadband Internet at home, and more than 443,000 households don't have a computer.[5]

As a result, many of the in-depth tech training programs interviewed for this report say they've had to turn away the majority of aspiring participants due to low levels of basic literacy and math skills. Of the 34 adult programs profiled for this project, 25 percent (9 of 34) say that too few New Yorkers have the fundamental skills needed to succeed in their program. Acceptance rates range from 100 percent for nearly all basic and introductory programs down to under 20 percent for the most in-depth, career-oriented programs. Among the most selective programs, a lack of proficiency in basic

Adult workforce tech training programs by focus*

Type of Program	Number of Programs	Locations
Basic Computer/Digital Literacy	101	170
Introduction to a Specific Tech Skill or Technology	114	127
Career-Oriented Training for Entry-Level Jobs in Tech	90	93
Total, basic/intro/entry-level	*305*	*390*
Career-Oriented Training for Mid-level Jobs in Tech	40	50
In-depth Career-Oriented Training for Jobs Requiring Advanced Coding and/or Engineering Skills	29	32
Total, mid-level and advanced	*69*	*82*

* includes for-profit bootcamps and CUNY continuing education programs

literacy and/or math skills was cited as the single greatest barrier. These more in-depth programs typically require participants to read and do math at a tenth grade level, while more basic digital literacy programs set a lower bar to entry.

"We have too many aspiring participants who are coming in with reading and math levels that are not strong enough to keep up with some of the work and earn a credential," says Racquel Forrester, former director of the web design and coding program at Opportunities for a Better Tomorrow, a nonprofit training organization based in Sunset Park, Bushwick, and Jamaica, Queens. "This is a huge, systemic barrier specific to the exact populations we want to serve."

Many organizations are at capacity and are prepared to scale up, but need support to do so.

Across nearly all of the more than 70 in-depth interviews conducted with program managers, one theme emerged again and again: demand for tech skills-building programs is surging, and most organizations lack the capacity to keep up with it. The largest nonprofit workforce training organizations focused on technology are serving no more than 800 participants annually, and most are serving between a few dozen and a few hundred. The K–12 programs identified in our research have the capacity to work with several thousand students, but the city's public school system contains more than 1.1 million. Many current initiatives could double or triple, according to program leaders, and still struggle to keep up with demand.

Organizations cited a variety of needs to achieve greater scale, including more than just programmatic funding: support for hiring and training instructors; capital funding to expand and improve physical spaces; stronger partnerships with city agencies and other nonprofit organizations; deeper relationships with employers, including those able to offer internships; and more flexible grant funding and city RFPs that can incentivize collaboration.

For both K–12 and adult programs, leaders cited the cost of high-quality programs and the challenge of hiring, training, and retaining skilled instructors as the greatest barriers to scaling up. Of the 38 K–12 programs profiled for this project, 76 percent (29 of 38) say that they have the demand to expand but lack the funding. Of the 34 adult programs profiled for this project, 32 percent (11 of 34) say that they

have the demand to expand but lack the funding.

"We have a pay-per-student model that today a lot of schools are choosing not to pay for," says Jerelyn Rodriguez, co-founder of The Knowledge House. "We should be able to provide our programs to low-income students of color citywide, but many schools are not prioritizing new STEM programs beyond the current curriculum. Instead, we've had to rely a lot more on philanthropy to scale to meet the demand, but that only goes so far."

"We could significantly expand the number of people served with a sustainable source of funding that allows for flexibility and nimbleness in program design and execution," says Kelly Richardson, the outgoing managing director of Per Scholas for New York and Newark. "It's the number one obstacle: funding that takes into account the expertise of providers to build programs that work and that doesn't come with really onerous oversight and reporting requirements."

Building a more diverse tech sector will require top-level focus from policymakers and civic leaders, and substantial new investments across the skills-building ecosystem.

Expanding pathways into technology careers for more New Yorkers from low-income backgrounds—including Black and Latinx New Yorkers who are significantly underrepresented in STEM fields—will require both significant near-term interventions and a large-scale, generational effort. Black and Latinx New Yorkers face a multitude of systemic barriers in both the education system and the workforce, including implicit bias in hiring, a lack of visible role models in both school and the workplace, and the cumulative effects of generations of underinvestment in families, communities, educational institutions, workforce development programs, and entrepreneurs of color.

But in some important respects the tide is starting to turn. Tech companies ranging from major global leaders to local start-ups are ramping up commitments to diversity and inclusion and increasing transparency around hiring practices, and major citywide initiatives starting with CS4All will greatly expand access to quality computer science education. But to help ensure that far more New Yorkers can gain access to the well-paying, fast-growing jobs being created across the tech ecosystem—and to develop a stronger pipeline of homegrown talent to fuel the city's expanding tech

Adult workforce tech training programs by focus, free and nonprofit

Type of Program	Number of Programs	Locations
Basic Computer/Digital Literacy	80	149
Introduction to a Specific Tech Skill or Technology	32	41
Career-Oriented Training for Entry-Level Jobs in Tech	29	32
Total, basic/intro/and entry-level	*141*	*222*
Career-Oriented Training for Mid-level Jobs in Tech	10	17
In-depth Career-Oriented Training for Jobs Requiring Advanced Coding and/or Engineering Skills	7	7
Total, mid-level and advanced	*17*	*24*

sector—much more needs to be done. To begin, it will require a new sense of urgency among city leaders that expanding and improving the quality of tech skills-building education should be among the top priorities for policymakers now and in the future. And the city should set clear and ambitious goals around accessing tech education from a child's earliest years; growing apprenticeship models and reducing barriers to work-based learning; boosting the number of STEM graduates who are Black, Latinx, and/or women; and greatly expanding the number of in-depth workforce training programs aligned with careers in technology.

Building the more diverse tech workforce of the future starts with supporting, expanding, and improving programs in the city's K–12 education system. Since 2015, CS4All has made major strides in ensuring that every New York City student has access to a computer science education. This initiative should become a key building block of the city's future investments, while additional resources should be focused on greatly expanding early integration of computational thinking. These investments should be targeted to close persistent gaps: for instance, our research finds that the broader landscape of K–12 STEM programs are still heavily weighted toward high school. By that time, most students have already decided for themselves whether STEM fields and computer science is for them—leaving behind far too many girls and young people of color who have not been exposed to STEM experiences earlier and don't see themselves represented in the field. Developing excitement

around technology and confidence in STEM skills needs to start from the beginning of a child's education, requiring deeper and more consistent opportunities to develop computational thinking skills from kindergarten forward. Our research finds that setting clear goals and launching new investments in early, integrated computational thinking education across grades K–5 could have the greatest impact on expanding access to technology careers over the long term.

At the same time, tens of thousands of working New Yorkers feel trapped in low-wage jobs with few opportunities for advancement and could benefit from expanded access to quality, career-oriented tech training programs. But far too few of the free and low-cost training programs available to working adults are aligned with tech careers; those that are typically operate at a very small scale; very few of these programs are embedded in low-income communities; and millions of New Yorkers lack the fundamental literacy and math skills required to participate in the most in-depth training. Meeting this growing need will require adding new programs aligned with growing tech occupations, expanding existing programs to meet rising demand, developing incentives and flexible funding streams that incentivize collaboration across the skills-building ecosystem, expanding supports for non-tuition costs like transportation and childcare, and ramping up bridge programs that provide crucial upskilling onramps to career-focused education and training.

SUMMARY OF RECOMMENDATIONS

The following is a brief summary of recommendations for policymakers, educators, nonprofit organizations, philanthropy, and the private sector. The full list of recommendations begins on page 100.

1. Make a significant new public investment in expanding and improving New York City's tech education and training ecosystem.

2. Set clear and ambitious goals to greatly expand the pipeline of New Yorkers into technology careers.

3. Prioritize long-term investments in K–12 computing education.

   – Fully fund and champion the expansion of CS4All to reach every student by 2025.

   – Go beyond CS4All to bring computational thinking into every classroom.

   – Significantly expand computing education in grades K–5.

   – Ensure that teachers at every grade level receive professional development in computing education.

   – Launch clear statewide standards for teacher certification and require a recognized credential in computing education for all new teachers by 2025.

4. Build the pipeline of educators and facilitators serving both K–12 and career readiness efforts.

5. Scale up tech training with a focus on programs that develop in-depth, career-ready skills.

6. Close the geographic gaps in tech education and skills-building programs.

7. New York City's tech sector should play a larger role in developing, recruiting, and retaining diverse talent.

8. Increase access to tech apprenticeships and paid STEM internships through industry partnerships, CS4All, and the city's current Summer Youth Employment Program.

9. Expand efforts to market STEM programs to underrepresented students and their families.

10. Develop and fund links from the numerous computer literacy and basic digital skills-building programs to the in-depth programs that can lead to employment.

11. Expand the number of bridge programs to provide crucial new on-ramps to further tech education and training for New Yorkers with fundamental skills needs.

12. Develop major new supports for the non-tuition costs of adult workforce training.

Methodology

To create this first-ever overview of the skills-building landscape for tech careers, the Center for an Urban Future compiled a dataset of nonprofit and low-cost tech skills-building programs available across the city for K–12 students as well as working adults, with a focus on programs that are accessible to lower-income New Yorkers. The complete list was assembled through a combination of online research, interviews with more than 130 experts working in the field, and data shared from a number of education and workforce organizations. Our team then selected 70 programs for in-depth profiles, based on factors including geographic reach, diversity of program approaches, reputation among peer organizations, and notable or distinguishing features. To assign specific tags categorizing the programs' curricula, duration, target demographic(s), geographic location, and other factors, our research team developed consistent variable definitions and reviewed those designations with program managers wherever possible. Once the dataset was fully assembled, our team then wrote Python scripts to generate summary statistics for the data, allowing us to find patterns and develop insights on the broader landscape. Developing this dataset, which includes data gathered between March and October of 2019, required significant human input, and it is likely that not every possible program was captured in our analysis. However, these findings provide the most comprehensive analysis to date of the size and scope of skills-building programs across New York City aligned with careers in technology.

Glossary of Terms

Computational Thinking refers to a set of a problem-solving processes, essential to computer and algorithmic applications, that involve breaking down a problem into parts, logically organizing data for analysis, recognizing and representing patterns through abstractions, developing step-by-step systems (algorithms) that can solve the problem and others like it, and evaluating the results.

A *Bootcamp* is an intensive technical training program that focuses on instilling foundational and industry-recognized skills, concepts, and knowledge in order to prepare participants for careers in tech.

Basic tech training programs are limited-duration courses that focus on teaching the fundamentals of operating a computer and performing basic day-to-day communication, research, and administrative tasks.

Intro tech training programs provide a limited-duration introduction to a specific digital tool, software application, or programming language, such as an introduction to Microsoft Excel.

Entry-level tech training programs are comprehensive enough to provide participants with the necessary skills and knowledge for entry-level tech or tech-adjacent roles, such as IT/network support technician, QA specialist, or help desk associate.

Mid-level tech training programs are intensive, months-long programs that provide in-depth, rigorous career-oriented training for in-demand tech roles that require proficiency in technical areas including programming, systems architecture, and/or design, such as front-end web developer, UX designer, or cybersecurity analyst.

Advanced tech training programs are the most in-depth and high-skill courses that we identified; these programs' comprehensive curricula often require multiple months of full-time study, and provide in-depth career-oriented training for tech roles requiring advanced coding and engineering skills such as software engineers or data scientists.

K–12 tech skills-building programs include both in-school or out-of-school programs that teach technology skills, computer science, computational thinking, and/or specific STEM concepts to students from kindergarten through high school.

Adult tech training programs include free, low-cost, deferred tuition, and scholarship programs accessible to lower-income adults. These programs serve adults over 18, including those who are unemployed or underemployed and looking to make a career transition, or enrolled in postsecondary education.

INTERVIEW FINDINGS

To produce this report, the Center for an Urban Future's research team conducted more than 130 interviews with program managers and directors of nonprofit and low-cost skills-building organizations focused on both K–12 students and adults, as well as tech executives and HR leaders, educators, city education and economic development officials, leading researchers, and other experts focused on diversity in tech. In addition to the key findings laid out in the first section of this report, the following captures additional challenges and opportunities surfaced during the course of our research.

in one company for shorter stints, fueling the need for constant recruiting.

Previously, many companies focused hiring in New York City on more experienced candidates. But as competition grows and compensation climbs, some employers say they are reconsidering. "We have a longer-term view now," says one HR leader for a mid-sized start-up headquartered in New York. "For more junior roles, we interview for problem-solving skills, intuition, and the ability to learn quickly, and then train in-house for our specific needs. But finding candidates with those qualities is a challenge."

"All of our jobs require tech savvy, even the non-coding positions—but we struggle to find enough talent to fill them."

Employers see a growing need to hire locally.

Across interviews and focus groups with founders and HR leaders from more than two dozen New York City tech companies, a consensus emerged that the competition for talent is increasing and more employers are looking for opportunities to hire locally amid growing demand.

"Our hiring landscape has gotten more competitive," says one HR leader of a ten-year-old Manhattan-based tech company. (All HR executives spoke to us on the condition that we would not use their names.) "If we do a phone screen and wait a week, that candidate has nine other offers. We have much lower acceptance rates than five years ago, and that's fueling the need for more talent in the pipeline."

HR leaders described several factors contributing to the need for more homegrown talent, including high turnover for certain roles that are demanding but often unglamorous, such as backend engineering positions like dev ops and platform infrastructure, and roles in quality assurance. In addition, a tight job market means that more experienced employees tend to stay

Employers are looking for more than just coding skills.

Employers tell us that they are searching for talent with a range of hard and soft skills—abilities that go beyond a background in computer science or even mastery of a specific programming stack. Hiring managers say they're looking for engineers with computational- and design-thinking skills, an aptitude for teamwork, and the capacity to learn and adapt. Specific competency needs run the gamut from front-end and back-end development to automation and machine learning, data science, cloud platforms, cybersecurity, and UX design. But no matter the role, employers say they're always searching for candidates who can solve unfamiliar problems and adapt as technologies change and new needs emerge.

"We need candidates with business instincts and a growth mindset," says one hiring manager for a Manhattan-based start-up working with blockchain technologies. "It's not just coding ability. It's the problem-solving skills to understand our competitive advantage in a crowded marketplace."

"We have a goal of helping a client company increase customer retention and conversion rates," says another HR director for a large e-commerce consultancy. "How can we design an experiment to test nudges to customer behavior? I don't just need talent to code it—I need someone who can help come up with the plan."

Employers also cite the growing need for non-engineering talent with tech fluency to fill an ever-expanding number of tech-adjacent jobs: technical salespeople, quality assurance, product and project managers, business development specialists, UX designers, and other low-code or no-code roles.

"All of our jobs require tech savvy, even the non-coding positions—but we struggle to find enough talent to fill them," says one HR executive for a large media company. "We need a much bigger pipeline in tech-adjacent roles like data insights, marketing, and product management."

House, a nonprofit tech training organization based in the South Bronx. "The challenge is that we're not getting enough employer feedback and there aren't enough incentives in place to spur companies to hire."

Adult workforce program participants struggle with the opportunity cost of training instead of working.

According to most adult-focused training programs interviewed for this report, a lack of basic literacy, math, and digital skills among working New Yorkers poses a significant barrier to access for those seeking training. But in addition to these skills barriers, 30 percent of adult programs profiled for this report say that non-tuition financial barriers pose a major obstacle to training for many low-income New Yorkers, including the opportunity cost of not working full-time while attending the program, the

"The best way to scale our program is with stronger and clearer employer relationships."

Many program providers say that cultivating and strengthening relationships with employers is a major need for the organization.

Across more than 40 interviews with tech skills-building programs for adults—and several others focused on preparing high school–aged students for college and careers—program managers say they understand the importance of having employers involved at every step of the process, from industry-informed curriculum development and specific credentialing to paid internships and apprenticeships. But many report challenges establishing these partnerships in the first place.

Program managers for both K–12 and adult programs cite specific needs around employer engagement, including support for more paid internships (at both the high school level and for adult programs); expanded employer engagement to understand specific skill and competency needs and develop effective training goals that are updated annually; and the need for volunteers to serve as curriculum advisors, instructors, or mentors.

"The best way to scale our program is with stronger and clearer employer relationships," says Jerelyn Rodriguez, co-founder of The Knowledge

length of the most in-depth programs, the cost of transportation, and the cost of childcare.

"A huge reason people don't finish training programs is that they can't afford to not be working," says Travis Tinney, director of development at ACE, a nonprofit focused on job training for homeless New Yorkers. "If you're in a program for a month and you're spending money to get there that you don't have, that's a sunk cost."

Those concerns are heard by organizers of more advanced training programs, too. "Applicants want to do it, but they need to work right away, so time and money are often the reason why they don't participate," says Racquel Forrester, formerly of OBT. "The demands of an intensive program make it hard to also work or be in school. The people we serve have too many very real and personal life barriers that too often keep them from enrolling and making the commitment."

In addition, several organizations at both the K–12 and adult levels say that a lack of paid internships and apprenticeships in STEM-related occupations means that low-income participants are forced to choose between taking any work that pays and sticking with a training or skills-building program. For instance, several STEM programs

focused on high school students say that competition from better-paying summer jobs and subsidized Summer Youth Employment Program jobs makes it harder to recruit low-income students to STEM summer programs.

"Our students want jobs that are going to pay them minimum wage, so they'll take a job at Rite Aid instead of doing a STEM summer internship, which would look much better on a college application," says Juli Schroeger, youth program coordinator at the Rockaway Waterfront Alliance, which runs science-focused camps and research mentoring programs for high school students. "It's yet another barrier to diversity and inclusion in STEM."

Both K–12 and adult-focused organizations need support for professional development

When it comes to building tech talent—whether through short-term workforce training or long-term investments in K–12 education—skills-building organizations themselves face their own talent shortages. For many adult-focused programs, it's the challenge of hiring and retaining industry professionals in a market where their skills are highly valued. In the case of K–12 programs, the challenge is around training teachers and instructors in the K–12 system to be able to integrate STEM and computational thinking curriculum and skills-building techniques into everyday class time.

Of the 38 K–12 programs profiled for this project, 24 percent (9 of 38) say hiring, training, and retaining skilled instructors is among their greatest challenges. To achieve in-school implementation of leading curricula, like Mouse.org's STEM and CS courses for grades K–12, teachers will need the time and mandate to receive professional development. But uptake varies significantly between K–5 and 6–12 schools. Program leaders say that an insufficient focus on professional development for elementary school teachers means that too few feel comfortable and equipped to integrate computing education into day-to-day homeroom lessons. According to Tom O'Connell, chief partnerships officer at Mouse.org, "78 percent of our teachers that come to the middle and high school professional development actually implement the course. That number from year to year for elementary ranges from 20 to 50 percent. So what that shows is that at the K–5 level, there's just not enough professional development—a one-day workshop is probably not enough."

Of the 34 adult programs profiled for this project, 24 percent (8 of 34) say hiring, training, and retaining skilled instructors is among their greatest challenges.

"We are searching for unicorns," says Jason Moss, president and founder of Metis, a network of data science bootcamps. "It's hard to find data scientists who are also great teachers—and tech companies are essentially fighting for them, too."

"A huge reason people don't finish training programs is that they can't afford to not be working."

K–12 PROGRAM PROFILES

Cornell Tech: Teachers in Residence

Teachers in Residence is a free professional development program offered by Cornell Tech that trains non-CS teachers in underserved elementary and middle schools in Manhattan, Queens, and the Bronx to integrate CS into their classrooms.

Who is served: K–8 non-CS teachers in schools where most students are Black and/or Latinx and eligible for free or reduced price lunch. Mostly grades 4–9, and fewer K–3 students

Number of participants: 150 teachers and 3,415 students served in 2018

Location: In school; multiple locations: PS/IS 217, Roosevelt Island, , Manhattan; Girls Prep Middle School, Lower East Side, Manhattan; Hunter's Point Middle School, Long Island City, Queens; PS 86, Kingsbridge Heights, the Bronx.

Fall 2019 additions: The Young Women's Leadership School, Manhattan, East Harlem, Creo College Prep Middle School, the Bronx, South Bronx, at least 1 additional school in Brooklyn.

Frequency/Duration: 1 to 3 days per week, entire school year (approx. 40 weeks)

Eligibility Criteria: The entire school, or an entire grade level or subject, must participate.

Curriculum: Computer Science Teachers Association (CSTA)- and NYS-standards-aligned curriculum focused on computer science and computational thinking; taught in the context of various non-CS subjects. Responsive to each school, with an emphasis on giving students agency with computing, and teaching them to use digital tools to build and problem-solve.

Partnerships: NYC FIRST, Tata Consultancy Services, Robin Hood, Siegel Endowment, CS for All, The Computer Science Teachers Association, NYC DOE/CS4All, CUNY, WiTNY (Women in Technology and Entrepreneurship in New York), Mouse

Cost: Free

Sources of funding: Private, support from Siegel Family Endowment and Pinkerton Foundation

What makes the program stand out? Teachers in Residence works closely and regularly with teachers throughout the school year, and that makes it unique among professional development programs. It also stands out for its requirement that the entire school, or an entire grade level or subject participate—an effort to overhaul a school's culture and practice.

What do participants need to succeed? A teacher trainer is assigned to each school for a year, helping teachers prepare hands-on collaborative lessons, observing teachers and providing feedback. Therefore, participating teachers need to be able to devote time before and after class for planning lessons and troubleshooting/debriefing with teacher trainers. And they need to be dedicated to working with teacher trainers for a full year.

What does the organization need? "One of the most difficult things for us is there's a very limited capacity of coaches," said Levitt. "I think we're just a little ahead of the curve. It's a time when there isn't so much expertise yet." Because the program is a very high-touch model, it demands coaches "who not only have a very high level of knowledge of the content, but also really great pedagogy," Levitt explained.

What overarching challenges face the CS education field? "I've been personally disappointed by the lack of response by schools of education who just do not seem to want to engage," said Levitt. This may owe to the expense of creating curriculum, and the lack of faculty with both CS and pedagogy expertise. Schools of education may also be waiting to see whether CS education is just a trend, suggested Levitt. "I do think there's a role for philanthropy to step up and help drive this, or public funding," she said.

Curriculum presents another hurdle. "There's a lack of high-quality curriculum, especially curriculum that has a scope and sequence from K to eight," said Levitt. There are often curricula targeting only 1 grade or age level, for example, whereas "a good sequential, joyful, rigorous curriculum--that's hard to find."

Genspace Biorocket Research Internship

Biorocket Research Internship is a genetic engineering and biology lab program for high school students provided by nonprofit community biotech lab Genspace in Sunset Park.

Who is served: High school students ages 15 and up who are minority groups in STEM. 80 percent of participants are from Title I schools.

Number of participants: 4 teams of 3 students each (12 students total) served annually

Location: Out of school; Genspace Lab in Sunset Park, Brooklyn

Frequency/Duration: 2 days per week after school from February to May, and 4 days per week 10 a.m.–2:30 p.m. for 7 weeks in July and August

Eligibility Criteria: Must be 15 years of age by July 1; attend a NYC public or charter school located within 45 minutes of Genspace; have a teacher or mentor reference; complete an application (including video or short essay); and commit to participating from February to May and in July and August.; Minority and low-income students are encouraged to apply.

Curriculum: STEM (biology/genetic engineering)-focused curriculum emphasizes lab and technical skills, computational thinking and design thinking, experimental design, digital literacy as well as the ethics of biotech. It's naturally aligned with but more advanced than NYS science education standards.

Outcomes: Biorocket is part of the NYC Science Research Mentoring Consortium (SRMC) led by the American Museum of Natural History, which is tracking whether participants enroll in college and pursue STEM majors/research. Genspace also tracks students' science knowledge and lab confidence through qualitative and informal interviews. Several alumni have gone on to work in other SRMC programs.

Partnerships: Pinkerton Foundation, NYC SRMC

Cost: Free, and student interns earn $2000 stipend for summer internship

Sources of funding: Private, Pinkerton Foundation

What makes the program stand out? The program begins with an afterschool component: 4 months focused on technical lab skills and soft skills. During the seven-week summer session that follows, students work in small groups to conceptualize, design, and prototype a biotech project, such as biosensors to detect metals in the water supply.

Lab programs such as Genspace which let students design their own experience rather than take direction are rare. Lab space alone is hard to come by in New York City's public schools, making Genspace uniquely valuable to the community it serves. Moreover, Biorocket replicates the project-driven learning approach of iGEM (International Genetically Engineered Machine), a competition that costs thousands of dollars, but Biorocket is free and pays students a $2,000 stipend.

The city's LifeSci NYC initiative, announced in December 2016, will put $500 million toward generating jobs in the life sciences over the next decade. But the industry faces the same equity and access dilemmas as other tech fields, according to Genspace Director of Education Beth Tuck. "If we're not very intentional and strategic about [diversity and inclusion] upfront and persistently, we're going to hit the same exact challenges." Biorocket represents an important step in the right direction, but it's very small and selective (they receive about 70 applications for 12–15 spots).

What do participants need to succeed? More funding so that they can be paid minimum wage, rather than the $2,000 stipend

What does the organization need? More funding and staffing, which could allow the program to reach more students. Better connections to other after-school programs, libraries and summer camps that could use elements of the program.

Rockaway Waterfront Alliance Environmentor Internship

Environmentor is an environmental science research program for underrepresented high school students in the Rockaways provided by the nonprofit Rockaway Waterfront Alliance.

Who is served: 9th, 10th, and 11th graders from high schools in the Rockaway Peninsula or adjacent city neighborhoods.

Number of participants: 12 students served in 2018; 15 students served in 2019

Location: Out of school program located at Rockaway Waterfront Alliance RISE Center, Queens, Far Rockaway; Field research settings around the Rockaway Peninsula and Jamaica Bay; Labs of New York City colleges/universities such as Brooklyn College and Hunter College.

Frequency/Duration: 8-month program includes once-weekly after-school classes from February–June, and 3 days per week of field research/lab work for 7 weeks in summer.

Eligibility Criteria: Students must be in grades 9–11 and live or go to school on the Rockaway Peninsula (or adjacent city neighborhoods). Students who have participated in the RWA Shore Corps Program as a prerequisite are given priority.

Curriculum: Environmental science curriculum with significant focus on computational thinking, field data collection, and lab work, including data analysis. Sometimes incorporates coding/computer science, such as with ImageJ, a Java-based image-processing program, and GIS mapping. Core skills taught include data collection, data analysis in a lab setting, technical lab skills, and science research.

Outcomes: 95 percent of participants are going on to college or trade schools, and more than 80 percent are studying or working in STEM-related fields.

Partnerships: Pinkerton Foundation, School partners include: Scholars' Academy**,** Channel View School for Research**,** Far Rockaway Educational Complex/Far Rockaway High School

Cost: Free and students receive a stipend

Sources of funding: Private. Most funding comes from the Pinkerton Foundation. Other funding sources include the Simons Foundation, Alfred P. Sloan Foundation, WT Grant Foundation and People's United Community Foundation.

What makes the program stand out? Enrivonmentor is one of only a few out-of-school STEM programs in the Rockaways, and the only one with a lab component. The program begins with weekly after-school classes at RWA's RISE Center, where students learn about data collection and the Rockaways' natural environment. Students are then paired with professional scientists from local universities for seven-week summer internships centered on a local environmental issue. They spend 3 days per week gathering data from around the peninsula and analyzing data in a college/university lab. Students then present their findings to the community through presentations and informational posters.

What do participants need to succeed? "I think some kids get scared away by science research," said program coordinator Julie Schroeger. RWA has struggled with recruiting, so it has adjusted its marketing and outreach language to reflect the program's less-academic activities, like kayaking and surfing; and to emphasize that it's also about gaining a better overall understanding of the community.

Participants also need better pay; the program pays a small stipend, but only some of the participants are selected (through a lottery system) for the city's Summer Youth Employment Program (SYEP), which pays minimum wage. "They want jobs that are going to pay them minimum wage, so they'll take a job at Rite Aid or CVS instead of doing this program, which would look much better on a college application. It's just another barrier to diversity and inclusion in STEM," said Schroeger.

What does the organization need? More funding to pay students a higher wage and to hire more staff, as well as capital dollars to purchase lab equipment and computers. "We take [participants] out and do more observational things and water-quality monitoring, but we don't have the capacity to have a lab," said Schroger.

Girls Who Code: Summer Immersion Program

Girls Who Code is a nonprofit organization that provides coding programs for female-identifying K–12 students nationwide. These students become part of a vast network of female-identifying coders who major or minor in computer science or related fields at 15 to 16 times the national average

Who is served: Rising 11th- and 12th-grade girls with little to no computer science experience. Students from underrepresented groups in STEM and those eligible for free and reduced price lunch are encouraged to apply.

Number of participants: 400 girls in the NYC area in 2018

Location: 22 sites in Manhattan and Brooklyn

Frequency/Duration: 5 sessions/35 hours a week, 7 weeks total

Eligibility Criteria: Female identifying, U.S. resident, rising junior or senior. Students are not eligible to apply if they: have already taken any AP/IB or other intermediate to advanced computer science course; reside and/or attend school outside the United States; have participated in the Summer Immersion Program in the past.

Curriculum: Participants learn different computer science principles each of the 7 weeks, with art, storytelling, robotics, and game- and web-development integrated into real-world projects. Programming languages include Scratch, Python, Arduino, C, HTML, CSS, JavaScript. The program also includes field trips to tech companies, guest speakers from the industry, and workshops that allow participants to meet female engineers and entrepreneurs.

Outcomes: Alumni who've declared majors are choosing to major in CS or related fields at a rate fifteen times the national average. Participants may connect with female engineers/entrepreneurs during the program as well as become part of an alumni network

Cost: Free; stipend available as-needed to offset transportation, living expenses, and lost wages. (Qualified recipients receive a sum of $300–$1400.)

What makes the program stand out? Few programs provide free coding instruction and professional skills-development during the summer, making this program a rare opportunity for the 400 annual participants served in New York City. But what sets this, and all of the organization's programs apart, is the in-house set of curriculum developers' focus on "building more than code; impact; and sisterhood," according to director of education Chrissy Zaccarelli.

Building more than code refers to building an underlying understanding of computational concepts, not just becoming experts in 1 language or being really good at debugging, "but understanding how to look at a problem; understand the puzzle pieces you have and the different ways they can fit together; moving towards a solution that also includes working with other people, wire-framing, talking to the constituents or stakeholders or audience that you want to serve with whatever it is you're building," said Zaccarelli.

"Impact" is about girls "building their very individual identities as computer scientists," through gaining an understanding of the diversity of women working in or with technology in numerous industries, whether an artist who's a technologist or a biologist who codes. "They can see that you can be a well-rounded person, and they don't have to give up their existing interests in order to pursue technology," said Zaccarelli. The "sisterhood" piece addresses that, for women in tech, "you need sponsors, you need mentors, you need cheerleaders, you need a support system." And "at that age where you're sort of figuring out who you are, if one of your friends is really into computer science, the likelihood that you'll persist is a lot stronger." In addition to a wide network of fellow alumni, Summer Immersion participants benefit from exposure to Girls Who Code's numerous corporate partners during field trips to tech companies and guest speaker events.

CUNY Early College Initiative

CUNY Early College, known as PTech, is a grade 9–14 model that combines high school and free college classes with professional work experience in tech, healthcare and media.

Who is served: NYC students in grades 9–14

Number of participants: A total of 3,283 students are enrolled in PTech schools, with 287 entering grade 13 this fall, and an estimated 97 entering grade 14. In 2018/19 school year, 1176 students across PTech schools were enrolled in tech-related courses, broadly defined.

Location: In-school as well as out-of-school workplace exposure and paid internships. Schools include: Business Technology Early College High School (BTech), Queens Village; City Polytechnic HS of Engineering, Architecture and Technology (City Poly), Downtown Brooklyn; Energy Tech High School (Energy Tech), Long Island City; Health, Education, and Research Occupations High School (HERO), Mott Haven; Inwood Early College for Health and Information Technologies (Inwood), Inwood; Manhattan Early College School for Advertising (MECA), Lower Manhattan; Pathways in Technology Early College High School (PTECH), Crown Heights

Frequency/Duration: Frequency depends on which courses students take. College-level courses can begin in grade 10 and continue through grade 14, or students can graduate after grade 12.

Eligibility Criteria: Early College is an unscreened public program aimed at students who wouldn't typically have access to tech-industry jobs. There are no academic criteria for admission.

Curriculum: Workplace learning curriculum informed by industry standards. Career goals, mentoring, guest speakers, workplace visits, and internships are woven into the program. Minimum requirements for entry-level industry jobs, as provided by industry partners, are mapped to the curriculum and serve as academic benchmarks. College-level coursework is CUNY-equivalent. Problem-solving, teamwork, and communication skills are a focus at each school.

Outcomes: Students get an AS or AAS and a high school diploma if they continue through grade 14. About 20–25 percent of graduating seniors go on to grades 13/14 for a complete bachelor's degree (often but not necessarily in STEM-related field). CUNY is just beginning to compile data on whether students are going into tech jobs, majoring in STEM, and/or graduating from four-year schools.

School/AAS & AS Degree Options:
BTech: AAS Internet & Information Technology, AAS Computer Information Systems;
City Poly: AAS Construction Management, AAS Civil Engineering, AAS Architectural Technology;
Energy Tech: AAS Energy Technician, AS Electrical Engineering, AS Mechanical Engineering, AS Civil Engineering;
HERO: AAS Nursing, AAS Community Health;
Inwood: AAS Cybersecurity, AS Biology;
MECA: AS Multimedia Programming & Design, AS Animation & Motion Graphics, AS Video Arts Technology, AS Digital Marketing;
PTECH: AAS Computer Information Systems, AAS Electromechanical Engineering Technology

Partnerships:
BTech: Queensborough Community College, SAP;
City Poly: CH2M Hill (an engineering company), BTEA (Building Trades Employers' Assoc.), MTA, RAND Architecture, City Tech;
Energy Tech: National Grid, Con Ed, LaGuardia Community College;
HERO: Montefiore Hospital, Hostos Community College;
Inwood: Bronx Community College, NY Presbyterian;
MECA: Borough of Manhattan Community College, Museum of Arts and Design, Paley Center for Media, 4A, 4A's MAIP (Multicultural Advertising Intern Program), Hearts & Science, J. Walter Thompson;
PTECH: IBM, City Tech

Cost: Free; students get free college credits

Sources of funding: Public (a DOE/CUNY partnership).

What makes the program stand out? Created in 2011 (as a single school named PTech) by CUNY, the DOE and industry partners in the technology, healthcare and media sectors, PTech was originally intended to create a pipeline of underrepresented New Yorkers into the tech industry. Students at any of the 7 PTech schools can accumulate up to 60 free college credits starting in grade 10, as well as gain industry exposure through paid internships, apprenticeships, job shadowing, and mentoring. They can opt to leave with a high school diploma or an AS or AAS degree; some students then transfer into the CUNY system to complete a four-year degree.

With the persistent barriers to diversity and inclusion in the tech industry, the PTech system represents a powerful opportunity to bring students directly into companies like IBM, National Grid and SAP—as well as into the CUNY system. And even if students don't continue through grade 14, they leave with a leg up in terms of college proficiency and readiness for college courses.

What do participants need to succeed? Students across all PTech schools have to make college proficiency before they can take college-level courses, and CUNY is still figuring out how to create a perennially marketable degree program that's also accessible to a diverse study body with special needs students and English language learners, according to Claire Riccardi, associate director of the CUNY Early College Initiative. More data around how to support incoming freshmen early on, as well as funding to allow for the right kind of staffing support could make a big difference, said Riccardi.

What does the organization need? More funding and data to help determine necessary staffing and extra supports (and subsequent staff training) that would help ensure all incoming freshmen able to access/succeed in the degrees being offered.

Professional development? DOE teachers get professional development through CS4All

Code Nation

Code Nation is a nonprofit organization that brings coding courses and work-based learning programs to students who attend under-resourced high schools.

Who is served: High school students in under resourced high schools in Brooklyn, Queens and Manhattan. 76 percent of participants identify as Black or Latinx, 44 percent identify as female or other, and 78 percent qualify for free or reduced price lunch.

Number of participants: 1,020 students served in New York City from 2018 to 2019.

Location: After-school at schools in Brooklyn, Queens, and Manhattan as well as at tech company offices.

Frequency/Duration: Up to 3 years total, Fellowship Courses: 31 lessons from October–June; Intro to Web Development Courses: 66 lessons from September–June

Eligibility Criteria: Schools where at least 75 percent of the student population qualifies for free or reduced price lunch.

Curriculum: 3 courses aimed at giving students exposure, experience, and agency with coding and coding concepts. The year-1 Intro to Web Development course (grades 9-10) focuses on coding exposure through HTML, CSS, and JavaScript. Year-2 Fellowship course (grade 11) focuses on project-based JavaScript concepts including APIs and professional skill development. Year-3 Fellowship course (optional, grade 12) offers more advanced APIs such as Firebase, as well as an intro to front-end frameworks and the fundamentals of ReactJS. Curriculum is updated annually with industry input. The two-day intensive summer Developer's Lab program helps students keep up with tech skills between courses.

Outcomes: 74 percent of reported alumni who completed 2 or more years of Code Nation programs are currently majoring or employed in STEM. 63 percent are studying or working in computer science.

By the end of the program, students have developed their LinkedIn and Github profiles and resume, along with a professional portfolio. Students will have also attended the annual Code Nation Hackathons. Students gain workplace experience through their fellowships at tech companies and field trips.

Partnerships: American Express, Etsy, Flatiron Health, Google, Major League Baseball Advanced Media, Oscar Health, Salesforce, Schrödinger, Teachers Pay Teachers, Uber, IEX, Seatgeek, Disney Streaming Services, MoneyLion

Cost: Free

Sources of funding: Private

What makes the program stand out? Code Nation emphasizes professional skills in the first year, particularly brainstorming, wireframing and public speaking. Technical skills are taught by industry experts, so students begin to develop real relationships with people in the industry and cultivate lasting networks. There's also an emphasis on independent problem solving and being able to communicate computational thinking, through whiteboarding activities and HackerRank challenges, for example.

Given the tech industry's struggle to hire and retain employees from nontraditional backgrounds, Code Nation's effort to create a tech pipeline of Black and Latinx students from under-resourced high schools is promising.

What do participants need to succeed? Participants attending schools in the outer boroughs are missing out on Code Nation programs because of a lack of tech-industry volunteers willing/able to go beyond Manhattan and certain parts of Brooklyn, according to Oppong.

What does the organization need? More volunteers from the tech industry (industry volunteers teach all programs); more volunteers in the outer boroughs.

Does it provide professional development? Yes

The Knowledge House: Exploring Technology

Exploring Technology is a customizable exploratory tech and computational thinking course for low-income, minority K–12 students in the Bronx led by tech-education nonprofit The Knowledge House.

Who is served: High school students in the Bronx

Number of participants: Roughly 200

Location:
Home base: 363 Rider Ave, 3rd Fl, Bronx, NY
Community organizations: Eugenio María de Hostos Community College, Nelson Management Group Ltd, Workforce 1
Schools: Bronx Aerospace, KIPP Academy, Wings Academy, Bronx Compass, Urban Assembly, Astor Collegiate, Bronx Latin, University Heights, BASE, Bronx International, AIM II New Visions, Ellis Prep, Bronx High School for the Visual Arts, Fordham STEP, YPIE

Frequency/Duration: The 80-hour modular curriculum is customizable. The summer SYEP-partnered program extends to 120 hours.

Eligibility Criteria: Students go through a standard application process but because Knowledge House works directly with teachers and school administrators, they often pre-select students.

Curriculum: Exploring Technology introduces tech skills including robotics, design and software. It also puts an emphasis on computational thinking and social emotional learning. The 80-hour modular curriculum also exposes students to pathways into tech careers, college programs and Knowledge House adult programs.

Outcomes: The organization runs 3 programs (2 for adults and 1 for K–12 students) that can be completed sequentially; alums can then take more advanced courses at the Knowledge House or through partner bootcamps. "The purpose is that they learn different pathways to pursue tech careers, [including] non-tech jobs, tech jobs, and tech jobs at non-tech companies," said co-founder and CEO Jerelyn Rodriguez.

The Knowledge House is also working to strengthen the bridge from its high school programs into adult programs and local colleges.; It spent a year aligning its Intro to Tech course to Hostos Community College's curriculum so that a student can matriculate with advanced placement and 6 college credits.

Partnerships: Mouse, DreamYard, Here to Here (helps KH connect w/certain schools in the Bronx), local CUNY schools (Hostos CC, that have pre-college partnerships w/high schools), Lafayette Boynton, NYC Workforce 1

Cost: Free for students

Sources of funding: Mixed

What makes the program stand out? Being small and neighborhood-oriented allows the Knowledge House to respond quickly and creatively to the needs of students, schools and CBOs as well as the tech industry itself. For example, when adult graduates came back to Rodriguez saying they didn't want to learn code but still wanted to work in tech, the Knowledge House found referral partners focused on design, cybersecurity or project management. They also began exposing K–12 students to a wider variety of skills and career options beyond coding.

The Knowledge House also stands out for its approach to staffing. The organization often hires program alumni rather than bringing in tech industry volunteers. "One of our value adds is all of our teachers are of color, because most of them are our alums," said Rodriguez. "We know that if we do a volunteer model, we'll have a diversity problem." (Staff of the Knowledge House lead K–8 sessions, while high school sessions are co-taught by DOE teachers and program alums.

What does the organization need? While the Knowledge House has the goal of being in every Bronx high school, it has struggled to expand now that schools get free professional development through CS4All and "they're not prioritizing their dollars for STEM programs" the way they used to, Rodriguez said. The Knowledge House has a pay-per-student model that "today a lot of schools can't afford."

Does the organization provide professional development? Yes. The Knowledge House has partnered with Mouse to provide professional development in computer science education to public school teachers.

Schools That Can: Maker Fellows Program

Maker Fellows is a professional development program offered by STEM-learning nonprofit Schools That Can that equips K-8 teachers in low-income communities to create and lead STEM maker spaces in their schools.

Who is served: K-8 teachers in schools in low-income communities

Location: Multiple school locations in the Bronx, Manhattan, Queens, and Brooklyn. See Appendix for full list.

Frequency/Duration: 90 minutes per week from September to June; teachers get 3–4 off-site trainings per year.

Eligibility Criteria: The organization's focus is on reaching K–8 schools where at least 60 percent of students are eligible for free and reduced price lunch, and that serve historically marginalized students. For Maker Fellows, schools must be committed to continuous improvement through collaboration with Schools That Can (STC) throughout the school year.

The organization also partners with "well-resourced independent schools," including charters and faith-based schools, some of which are eager to share their "highly resourced maker spaces" with lower-income schools.

Curriculum: Professional development program equips teachers to lead project-based maker education curriculum focused on CS and STEM, problem-solving, critical thinking, collaboration and persistence. Partly aligned to NGSS, common core, K–12 CS Framework.

Outcomes: Teachers running STC maker programs (in Chicago, Pittsburgh, Newark, St. Louis, NYC) demonstrated a 27 percent increase in ability to incorporate CS and computational thinking into classes. 85 percent of students in STC maker programs can picture themselves in a job using computers.

Partnerships: Da Vinci Schools; Next Generation Learning Challenges; Robert F. Kennedy Human Rights; Student Success Network; Dream See Do; 180 Skills; Maker State; The Research Alliance for NYC Schools; Horatio Alger Association

Cost: Free

Sources of funding: Private

What makes the program stand out? While it also partners with middle schools, STC is among the few organizations focused on professional development for K–5 teachers, and that emphasizes computational thinking skills for elementary school students. Younger students "naturally want to be tactile and creative," and have little opportunity for that during the school day, according to Roger Horton, manager of STC maker programs in New York City. Maker education is also a natural vehicle for teaching students problem-solving, critical thinking, collaboration and persistence, according to research by Schools That Can.

What do participants need to succeed? To overcome negative stereotypes around girls in STEM: Research by STC has found that such perceptions may take root as early as third grade.

Less complications around paying for programs and more basic resources. "There's a lot of bureaucracy that principals have to go through . . . Most school leaders get that the earlier you start [with STEM and maker programs], the better," said Horton, but they face challenges around "having the right staff and hardware in place."

What does the organization need? Funding. STC wants to expand its Career Skills program for high school students, a career pathway program that aligns to CTE standards and includes help navigating curriculum options, mentorship/internships, and college credit opportunities.

How can the city make the most of the tech skills-building and industry assets it already has? "I think New York should keep thinking about how to coordinate efforts across the city, remove duplication [in programs] and cover those areas [where there] are gaps," such as the far reaches of Queens (Flushing, South Richmond Hill, for example), said Horton. Additionally, he'd like to see the city helping connect schools/programs in those more remote neighborhoods with major tech employers, such as airports and the maritime industry.

BEAM (Bridge to Enter Advanced Mathematics)

BEAM is a nonprofit organization that offers free programs for underserved middle and high school students that explore high-level mathematical concepts and ways of thinking, rather than school-based math.

Who is served: Students in grades 6–12 in the Bronx, Upper Manhattan and Chinatown, Brooklyn, and Queens who are underrepresented in STEM (90 percent black or Latinx, half female, 70 percent first generation to go to college; family income is $30,000 or less).

Number of participants: 200 rising 6th graders in Discovery summer program; 80 students are accepted to Pathway in NYC per year; 400+ alumni in grades 8–12.

Location: Pathway summer program is held at college campuses (this year at Bard College and Union College). Subsequent school-year programming is at BEAM offices in Manhattan's Financial District.

Frequency/Duration: Discovery (Summer program for rising 7th graders): 5 weeks, 5 days per week, 7 hours per day. Pathway (five-year summer program for rising 8th- through 12th-graders): 3 weeks, 5 days per week, 7 hours per day. During 8th grade: Algebra I course, private tutoring & enrichment courses. High school: classes every Saturday, drop-in hours.

Eligibility Criteria: Highly competitive admissions process, but with no consideration of test scores. Students must be ready for advanced math (most students who are admitted to Pathway have completed Discovery program the year before). Priority given to those who come from lower-income families or wouldn't otherwise have access to similar programs.

In addition to Discovery/Pathway programs, BEAM partners with 35 public schools in Brooklyn, the Bronx, Manhattan and Queens where the majority of the student population is eligible for free and reduced price lunch and Black or Latinx.

Curriculum: BEAM doesn't reinforce school-based math, except for the Algebra 1 course preparing 8th graders for the Regents. Rather, "the key is thinking," said Lynn Cartwright-Punnett, BEAM senior director of programs, including critical reasoning and abstract thinking, as well as how to see patterns, determine whether something can be proven, and organize mathematically.

Discovery/6th-grade summer program: 4 classes in Logic, Math Fundamentals, Math Team Strategies, and Applied Math. Faculty have "free reign" for applied math courses and some focus on coding. Career day visits/guest speakers, and tours of STEM-related workplaces included.

Pathway: 7th-grade courses change each year and can include number theory, incidence geometry, logic, astrophysics, computer programming. Some students learn Arduino, Python, Java, Alice (not block-based coding/Scratch); 8th grade: focus on Algebra 1; High school: SAT/ACT prep.

Outcomes: Help applying to high schools in 8th grade; Support during 9th and 10th grade through the BEAM Next Saturday program, assistance with applying to future summer programs; free SAT/ACT prep courses; advising to assist with getting college scholarships; dedicated support for college students majoring in STEM fields.

Partnerships: Partners include 34-36 partner middle/high schools in Manhattan, Brooklyn, Queens and The Bronx, as well as Bard College and Union College. See appendix for full list.

Cost: Free

Sources of funding: Private. Major supporters are Jack Kent Cooke Foundation, Simons Foundation.

What makes the program stand out? BEAM is one of the few programs in New York City taking direct aim at the disparity in higher-level mathematics between Black and Latinx students and their white and Asian peers, as part of its mission to diversify STEM fields.

Math is recognized as a critical pathway into STEM subjects. Beyond sparking students' interest in math before high school (especially in New York City, where only 40 percent of public high schools offer calculus) BEAM propels students into additional extracurricular opportunities in STEM, such as math contests and other summer programs which will help students stand out on in college admissions. Most students are unaware of the wide range of professions that a higher degree in math can lead to. BEAM exposes students to different pathways to success, like working at the NSA, becoming a professor or consulting at Google.

What do participants need to succeed? Students have requested a trigonometry refresher class prior to AP subject tests, which BEAM provided, along with opportunities to learn computer programming. Another need has been social and emotional support for students from nontraditional backgrounds (often Black and Latinx students) who are accepted into top high schools that don't reflect the demographics they were used to in middle school. BEAM began offering social worker-led young men's and women's groups, where students can talk about whatever is on their minds.

Although students are digital natives, according to Cartwright-Punnett, they need guidance with professional/workplace skills like how to archive email, for example, and advice on "what it's like to be a woman in 21st-century America."

NYC FIRST STEM Centers and Robotics Programs

The nonprofit mentoring organization FIRST operates 2 New York City STEM Centers that provide free robotics education programs for underserved high school students.

Who is served: Robotics programs: all K–12; STEM Centers: students attending under-resourced high schools

Number of participants: Approximately 7,000, including 150 in credit-bearing courses

Location: STEM Center at Cornell Tech: Energy Tech HS, The Young Women's Leadership School of Astoria, High School for Environmental Studies, Legacy High School. STEM Center at NYPL's Washington Heights Branch: Gregorio Luperón HS, Washington Heights Expeditionary Learning School (WHEELS), City College Academy of the Arts, University Heights HS. Out of school robotics programs: locations around NYC.

Frequency/Duration: Credit-bearing courses: 3 hours per week throughout the school year

Eligibility Criteria: None

Curriculum: Structured around the FIRST Tech Challenge robotics competition, and tied to what students are learning in school. Core skills taught include coding, 2D and 3D design and fabrication, circuitry, collaboration, project management, and computational thinking. Languages taught include Java and Python for Raspberry Pi, and C for Arduino.

Outcomes: Students earn high school credits at STEM Centers. A pre/post-program survey measures baseline skill level and social-emotional learning progression.

Partnerships: NYC DOE, Cornell Tech, NYPL, BPL, QPL

Cost: Free for STEM Centers

Sources of funding: Private (foundation, corporate and individual support)

What makes the program stand out? FIRST is known for its annual Robotics Competition, where teams of high school students guided by professional engineers create industrial-size robots that compete against each other. College scholarships are offered. Students can also join teams as early as kindergarten to learn how to code with LEGO Education WeDo 2.0; older elementary- and middle-school student teams use LEGO Education MINDSTORMS EV3 to design and build robots.

While the robotics programs create excitement around technology, teams must find financial support or apply for grants to cover registration fees. NYC FIRST STEM Centers stand out for introducing similar content to underserved high school students at no cost, and with guidance from trained educators who emphasize computational thinking.

It's also one of the rare programs that goes beyond having students memorize different coding languages. "We put a lot of emphasis on understanding the logic of how these [coding] languages work, and why they should use them and how to combine them," said instructor and program manager Francesca Rodriguez. In the fall, students are introduced to programming with Java, Python for Raspberry Pi and C for Arduino, as well as physical computing (including 2D and 3D design and fabrication, and circuitry). In the spring, students apply what they've learned by designing and building a technological solution to a problem in their community.

What does the organization need? Funding and more awareness in the community that the STEM Center is a resource for everyone living in the neighborhood. Students from Crown Heights and the Bronx have also come in to use the equipment, and this is the sort of resource-sharing that the STEM Center wants more people to know about.

STEM From Dance

STEM From Dance is a Brooklyn-based nonprofit that uses dance to teach STEM concepts to middle and high school girls of color from low-income backgrounds.

Who is served: Middle- and high-school Black and Latinx girls ages 12–18 from schools in low-income communities in Brooklyn

Number of participants: 216

Location: In school during the school year: the Highbridge Green School, Uncommon Collegiate Charter High School, New Heights Middle School, Children's Aid P.S. 219, Opus Dance Theater. Summer camp at Bishop Loughlin Memorial High School.

Frequency/Duration: Varies according to school needs, from one 2-hour session per week up to 5 hour-long sessions per week; for the semester or full school year; 3-week daily summer camp.

Eligibility Criteria: Camp requirements: New York City girls ages 12-18; must arrange their own transportation to and from camp, and attend the full 3 weeks, Monday–Friday, 9 a.m. to 3 p.m.. No previous coding or dance experience necessary

Curriculum: Curriculum combines choreography principles with software and electrical engineering principles as students create a dance routine that combines the 2 realms. Participants use computational thinking to create a dance piece that incorporates technology. This can include wearable tech, such as costume accessories that light up and have sensors that are input to a circuit, for example. Participants might also design projections to add intrigue to a dance performance. While learning block-based coding, circuitry, and how to create dance in a way that is responsive to tech, girls also learn to be part of a team. Programs culminate with a performance.

Outcomes: 40 percent of participants increased their confidence; 50 percent had a more positive attitude towards STEM; 80 percent increased their STEM proficiency. Students are guided toward other STEM programs and internships with partner organizations such as dance companies (including Brooklyn Ballet).

Partnerships: Schools: the Highbridge Green School, Uncommon Collegiate Charter High School, New Heights Middle School, Children's Aid P.S. 219, Opus Dance Theater. Nonprofits: Code Nation. Companies: dance companies such as Brooklyn Ballet.

Cost: Free for students in school programs; camp is $425 (total for 3 weeks, including lunch) with scholarships available.

Sources of funding: Mixed: funded through Department of Cultural Affairs and subcontracted through the Department of Youth & Community Development (DYCD). Also receives funding from foundations and individual giving.

What makes the program stand out? Students of nontraditional backgrounds rarely see themselves reflected in STEM fields, and subsequently don't imagine themselves pursuing STEM careers. STEM From Dance takes a unique approach to correcting this misperception: introducing girls of color to coding and circuitry through a nontraditional lens that resonates with them. Moreover, the programs teach girls to be leaders and computational thinkers by allowing them the freedom to create and perform their own tech-enhanced choreography.

What do participants need to succeed? A shift in perception around tech and STEM and where they might fit into that world. For most participants, this program is their first experience with computer programming/circuitry; once they're introduced to the curriculum they tend to respond well.

What does the organization need? Identifying partner schools is a challenge and having greater staff capacity could help. Finding staff that fit the role, are well-qualified, and that students can relate to.

Sunset Spark

Sunset Spark is a nonprofit that provides free creative technology programs in Sunset Park K–8 schools with majority immigrant populations.

Who is served: K–8 (mostly elementary) schools where student population is at least 85 percent from immigrant families; also students with disabilities and ELL students in Sunset Park, Brooklyn.

Number of participants: ~2,000 students in-school 2018–19

Location: In-school programs at P.S. 24, 971, 516, 169, and 131. After-school program at M.S. 136 and M.S. 821. Drop-in programs at the Sunset Spark office at Industry City

Frequency/Duration: Classes during the school day based on school needs for 10–14 weeks throughout the school year; clubs and drop-in hours.

Eligibility Criteria: K–8 public schools and community-based organizations in Sunset Park are eligible.

Curriculum: Schools decide what they need: robotics (3rd–5th grade), game development, coding, or computer engineering. Curriculum is written by the 2 founders. It's project-based and student-driven, and they work with dual language and self-contained classrooms, and do Integrated Co-Teaching (ICT).
Skills taught include computer science, computational thinking, coding (Python, Lua, Scratch, Hopscotch), and robotics.

Outcomes: While programs only became fully operational in 2013, several alumni have been accepted into specialized high schools, for example.

Partnerships: DOE (Sunset Spark works with the DOE's CS4All effort; they wrote the K–2 CS4all curriculum). Nonprofits/companies: Sunset Park Library, Atlas:DIY, Muslim Community Center, Industry City.

Cost: Free to participants

Sources of funding: Most funding comes from schools that pay for services. Also paid by the DOE for writing curricula.

What makes the program stand out? Sunset Spark stands out for building a neighborhood culture around creative technology. The organization provides teacher training and works across entire grade levels in partner schools, including dual language and special needs classrooms. Students can also join after-school clubs and attend drop-in hours at Sunset Spark's offices. Parent workshops in tech and child development are also available. Being immersed in the neighborhood makes it easy for instructors to get to know students' families and stay involved with them over multiple years, said founder Gaelen Hadlett. Parents can more easily accompany their children to drop-in hours or after-school programs, and siblings and cousins often join programs together.

They're also one of the few programs to prioritize working with immigrant students, including Spanish-, Chinese-, and Arabic-speaking immigrant students. "Kids in the class get really excited, especially if they just moved to the country and this is something they can do that doesn't involve them having to figure out English," he said. "We try and make it as accommodating as possible for the kids. When I'm teaching coding, if I find out there's a kid in the class who doesn't speak English, I'll pair them with someone who speaks their native language," and make sure the iPad and apps they're using are set to their native language, so they can follow along with the lesson.

What do participants need to succeed? Most are English language learners and many are special needs students; all need particular types of support when it comes to learning computer science.

What does the organization need? The schools they work with are budget-constrained, so Sunset Spark will charge schools what they can afford. Hadlett sees schools' lack of funding for these types of programs as one of his organization's biggest challenges.

City Parks Foundation: Green Girls

CityParks Learn is the STEM-education arm of the City Parks Foundation that includes environmental science programs for underserved K–12 students throughout New York City.

Who is served: Middle school girls ages 10–13 from low-income backgrounds

Number of participants: 40

Location: Summer: IS 204 Oliver Holmes, Long Island City. After-school during the school year: IS 204 Oliver Holmes; MS 577 Conselyea Preparatory School, Williamsburg; K 366 The Science and Medicine Middle School, Canarsie; Fannie Lou Hamer Middle School, Crotona Park East.

Frequency/Duration: Summer: 4 days per week, 6 hours per day for 5 weeks total. After school: September–June: once per week for 2.5 hours

Eligibility Criteria: The application takes into account interest in the environment, but there are no test scores/grades involved in process. City Parks aims to reach low-income minority students.

Curriculum: STEM program focused on teaching environmental science through hands-on projects that can include data science. For example, participants have built their own temperature sensors to collect temperature data inside and outside parks and used computers to do data analysis.

The program centers on visits to urban forests of NYC parks and waterways in all 5 boroughs, where participants conduct fauna surveys, including an annual dragonfly survey. They also learn about science careers and go birdwatching and canoeing, as well work closely with the Parks Department Stewards program to learn about and remove invasive plants.

Outcomes: Paid high school interns are trained to lead the 5 K–8 programs, while receiving career and college prep. Green Girls participants can apply for these internships.

Partnerships: NYC Parks (Stewardship program)

Cost: Free

Sources of funding: Mixed (foundations and City Council)

What makes the program stand out? There are numerous environmental science education programs available around the city, but very few if any free summer camps focused on urban ecology across the 5 boroughs. The program is aimed at reaching girls from under-resourced neighborhoods, which are facing environmental degradation themselves, according to director of education Chrissy Word. Green Girls is also an example of how difficult it can be, even for long-running (founded in 2002) and popular programs (100+ student waitlist) to integrate technology into curriculum. Green Girls has done so with varying success, largely due to a lack of funding which impacts staff retention.

What does the organization need? Retaining educators with technical knowledge has been challenging, thwarting efforts to integrate more advanced technologies. Attempts to incorporate Remote Operated Underwater Vehicles (ROVs) into Green Girls have "not flourished," said Word, and Learning Gardens (another Parks Foundation program) hasn't kept pace with developments in urban agriculture. More consistent industry partnerships could help fill in the technical gaps, while also helping high school interns access jobs, said Word. The Foundation's Coastal Classroom program, for example, could be feeding students into maritime trades with the Port Authority. "There should be a real pipeline right into those tech jobs," she said.

Lack of space is a challenge, too. The Foundation is housed by the Parks department in 4 different locations around the city; "This is kind of where they've been able to put us," said Word. "Even if I got a bump in funding and was able to grow the programs, space for staff would be an issue."

BioBus: Mobile Lab

BioBus is a nonprofit organization that provides underserved students around New York City with free hands-on biology lessons inside a mobile lab.

Who is served: Minority, female and low-income pre-K–12 and college students throughout New York City

Number of participants: 60,000 among all programs

Location: On the BioBus parked on school grounds during the school day (over 100 NYC schools visited)

Frequency/Duration: 45-minute sessions (the BioBus can remain parked at a school for 1 or more days in order to serve as many students as the school would like; cost goes up for additional day(s); the Bus can see a maximum of 6 classes per/day of 30 students max, or about 180 students in a single school visit).

Eligibility Criteria: No requirements to qualify.

Curriculum: Aboard the BioBus, scientist-teachers lead science lessons that follow New York State grade-level learning objectives and teach general skills of science inquiry and process, such as knowing how to make and understand an observation and how to develop and test a hypothesis. Lessons are tied to what students are learning in class as much as possible.

Outcomes: The organization has measured significant changes in students' attitudes toward science after spending only 45 minutes on the bus. Students in a 12-week after-school program displayed a similarly significant shift toward identifying as scientists.

Students may have the opportunity to continue programming at summer camp as well as Pursue (paid internships for high school and college students) and Explore (8- to 12-week programs at schools and community centers incorporating more research practice), all held at BioBase Harlem at Columbia's Zuckerman Institute or the BioBase Lower East Side location.

The paid internships allow students to develop a science research project while mentoring younger BioBus students. Interns also benefit from the organization's network of scientists, who often guide interns toward research opportunities and college programs.

Partnerships: Columbia's Zuckerman Institute, Variety Boys and Girls Club of Queens, Lower Eastside Girls Club (LESGC), Lower East Side Ecology Center, NYU Materials Research Science and Engineering Centers (MRSEC), Billion Oyster Project, BrainNY, Greater NYC Chapter of the Society for Neuroscience
Dana Foundation's Brain Awareness Week, Columbia SEBS (Science and Engineers for a Better Society), Earth Day NYC, Girls Prep, Harlem Week, HypotheKIDS, Imagine Science Films, Lowline Lab, Maker Faire, Math For America, New York Hall of Science (NYSCI), New York City School District 1, NYC Department of Education Citizen Science Program, NYC Department of Youth and Community Development, RockEdu (Rockefeller University Science Outreach), World Science Festival

Cost: Free

Sources of funding: Mixed (City Council, DYCD, NYS Assembly and numerous private donors)

What makes the program stand out? Science labs are something of a luxury in New York City public schools, and BioBus is helping fill in the gaps. "We can go to schools [in low-income communities and/or that don't have labs] and provide them with an $85,000 microscope and change that landscape in a really radical way," said founder Ben Dubin-Thaler.

What do participants need to succeed? "One thing [the city] could do is live up to their own rule: students are supposed to have labs in school. It's a state requirement and the city does agree in principle, but we need to make the investment to make sure [that it's actually happening]," said Dubin-Thaler.

What does the organization need? Direct funding and/or more funding for schools.

CAMBA After School

CAMBA is a nonprofit organization that provides STEM learning activities for underserved elementary and middle school students in Brooklyn.

Who is served: K–8 students from low-income communities in Brooklyn. Majority are living in poverty; more than half are immigrants or refugees.

Number of participants: 1,988 (not including Beacon/Cornerstone center participants)

Location: 2 Middle Schools: SONYC at Huddel, SONYC at Whitman M.S. 72. 9 Elementary Schools: CAMBA All-Stars at P.S. 114, CAMBA Creative Kids at P.S. 139, CAMBA Elite at P.S. 3, CAMBA Kids Connection at P.S. 249, CAMBA Kids Shine at P.S. 361, CAMBA Kids Unite at P.S. 170, CAMBA Kids Unlimited at P.S. 92, CAMBA Kids World at P.S. 269, STARS Drug Prevention at P.S. 249. 1 homeless shelter: SONYC at Flagstone Family Center. 4 Beacon community centers and 4 Cornerstones

Frequency/Duration: After-school every weekday for 3 hours per day, including holidays. Summer program for 7 weeks, 10 hours per day.

Eligibility Criteria: None, other than being enrolled at the school where the program is being offered.

Curriculum: CAMBA provides STEM activities as part of its after-school and summer educational programs for elementary and middle school students in Brooklyn. Across school sites, CAMBA delivers STEM education in 4 ways: through purchased curriculum, such as After-School Science PLUS, an inquiry-based curriculum that uses hands-on activities to teach physical science; subcontracts with STEM-focused organizations such as Digital Girl, Beam Center and KoKo; a partnership with ExpandEd Schools Pathways: Computer Science, which trains CUNY students to teach CS to upper-elementary and middle school students; and inquiry-based field trips year-round to the New York Hall of Science and American Museum of Natural History, for example.

CAMBA takes a similar approach at Beacon and Cornerstone Community Centers, including through partnering with NYU's Tandon School of Engineering to bring a lab-based program called Creativity in Engineering, Science and Technology (CrEST) to Beacon sites during K–5 summer camps.

Outcomes: Students participating in Beacon/Cornerstone programs have been hired to lead those programs.

Partnerships: Colleges/universities including NYU, CUNY; DYCD, which leads COMPASS and SONYC; nonprofit STEM orgs such as Beam Center, Digital Girl, City Science, KoKo, ExpandEd (subject to change annually).

Cost: Free

Sources of funding: Mixed

What makes the program stand out? CAMBA reaches some of the Brooklyn neighborhoods most in need of STEM/technology-skills training. The organization's after-school programs also serve more students than small nonprofits are usually capable of reaching. CAMBA's reach alone is noteworthy, as are its year-round offerings and efforts to partner with nonprofit providers of STEM programming such as Beam Center and City Science. While computational thinking is not necessarily an overriding focus of CAMBA's STEM programming, senior vice president of education & youth development Christie Hodgkins strives for programs to foster critical thinking around STEM subjects.

What do participants need to succeed? More consistent programming and instructor expertise in STEM across K–5 and 6–8 after-school programs.

What does the organization need? Daily after-school programs are funded in part through the DYCD's COMPASS and SONYC program models. While SONYC programs, aimed at middle school students, are "funded at a level to hire specialists in STEM as well as subcontractors, COMPASS Elementary programs are not," said Hodgkins. CAMBA tries to fund subcontracts for COMPASS programs through accruals in other areas, but that's an unpredictable, year-to-year method. "It concerns me because [programming is] not consistent across our elementary school sites," Hodgkins said. The model "has to be funded at a higher level to support this level of quality" expected by DYCD.

ELiTE Education (Emerging Leaders in Technology and Engineering)

ELiTE is a Harlem-based nonprofit that helps local middle and high schools improve the quality of their computer science and engineering education.

Who is served: Middle and high school students in Harlem, East Harlem, and Washington Heights. Among participants, 96 percent are Black or Latinx; 70 percent or more are eligible for free and reduced price lunch.

Number of participants: 348

Location: 4 middle and high schools in East Harlem/ District 4: Manhattan Center for Science and Math HS (M435); The Lexington Academy MS (M072); Isaac Newton MS (M825); Renaissance School of the Arts MS (M377)

Boys and Girls Club of Harlem
Google CodeNext, Harlem

Frequency/Duration: Twice-weekly co-teaching in middle and high schools. One hour per week of instructional coaching for CS, technology, and engineering teachers throughout the school year. 4 hours per month of leadership coaching and management support for middle and high schools

Eligibility Criteria: Currently only working with schools in Districts 4, 5, and 6.

Curriculum: ELiTE delivers services to middle and high schools through 4 pathways. First, it increases CS/ technology/engineering teacher capacity by providing curricula as well as instructional coaching, and by bringing in student teaching fellows with CS/technical expertise to co-teach twice a week. Secondly, ELiTE helps school leaders increase their benchmarks for student performance, enabling the "more rigorous profile in the maths and sciences" required of college STEM majors, according to ELiTE founder Chelsey Roebuck.

A school's college and guidance counselors also receive support in preparing students for STEM-focused degrees and careers, such as through ELiTE-led summer bridge programs before students enter high school, as well as weekly after-school programming throughout the school year. In 6th grade, the curriculum focuses on basic computational thinking skills, often with math remediation (in most of the schools ELiTE works with,

students are 1 to 3 grade levels behind in math and ELA). 7th and 8th grade brings an introduction to physical computing (using electronics and circuits, but also computers to program those electronics and circuits).

K–5 students are reached through ELiTE's Lego Robotics partnership as well as through out of school time programming in partnership with the Boys and Girls Club of Harlem, whose K–5 program staff received STEM-focused professional development from ELiTE staff.

Outcomes: Roebuck estimates approximately 20–30 students per year from ELiTE programs go into rigorous CS or engineering college/university programs at schools including Hunter College and City College. ELiTE tries to be "intentional about connecting [students] to pathways where they can apply [CS skills] in industry," said Roebuck. That includes everything from "connecting them to research labs or opportunities where they can use computer science as their way into a biomedical-engineering, chemistry or mechanical engineering lab." ELiTE also tries to connect students to industry-focused opportunities or internships, from summer programs like All Star Code and Girls Who Code (which has internship programs at companies like Goldman Sachs), to supporting students through their own technical internships (a graduating senior who attended ELiTE programs is a technology intern at Bloomberg for the third straight summer).

The organization is also tracking several engagement metrics (number of students served, hours served in various types of programs) and impact metrics (grit, confidence, interest in science/engineering) through daily attendance records and pre- and post-program surveys.

Partnerships: District 5: UA Academy for Future Leaders MS (M286), Frederick Douglass Academy MS/ HS (M499), UA Academy for Social Action HS (M367); District 4: Manhattan Center for Science and Math HS (M435), The Lexington Academy MS (M072), Isaac Newton MS (M825), Renaissance School of the Arts MS

Community Program Partners: Boys and Girls Club of Harlem, Google CodeNext, NYC FIRST Robotics, Facebook TechStart

Cost: Free

Sources of funding: Mixed; City funding (DYCD), individual schools, corporation/foundation grants, earned revenue for curriculum development, program development, and training sessions.

What makes the program stand out? ELiTE is unique in its comprehensive approach to school partnerships. The organization guides school leaders and guidance counselors, and offers professional development in computer science and engineering education for teachers, while also providing after-school computer science classes at schools, a variety of CS programs at the Boys & Girls Club of Harlem, and internship/college/career guidance. Together, these efforts help create a clearer pathway into the tech industry for students from non-traditional backgrounds. "Imposter syndrome is real," said Roebuck. Underrepresented students "really do need to be able to see, experience, and appreciate that they fit in and belong in these environments, and that they can be successful in these environments. And the only way to do it is through hands-on practical experience."

What do participants need to succeed? Programming that goes beyond a one-off CS class, and a clear pathway into those other programs. Guidance around internships, industry opportunities and college. Also extra support in math and ELA.

What does the organization need?
Also, a clearer route to collaborating with the DOE, and more incentive among different DOE buckets (such as the Algebra team, CS team, STEM team) to work together: "We can have 1 initiative and have it funded by 3 or 4 different [DOE] teams or offices. There doesn't really seem to be a clear, streamlined way or process to make that happen currently in the DOE, at least through their channels."

Roebuck also said that demand is always greater than their capacity to staff or fundraise since they try to keep schools' contribution to a program's cost to less than 35%.

Beam Center

Beam Center is a nonprofit that provides creative engineering workshops in underserved public schools throughout the city, as well as hosts high school apprentices at its Red Hook production space.

Who is served: K–12 schools in Brooklyn, the Bronx, Manhattan and Queens that serve predominantly low-income students of color and new immigrants. Majority of partner schools are Title I, and half are in the International Network for Public Schools.

Number of participants: School partnerships: 6,000 (4,500 during school year and 1,500 over summer (this includes STEM Summer in The City, CareerCLUE and SYEP Younger Youth). Apprenticeships: 50 Beam Project Leaders, 70 Summer Youth Employment Older Youth job placements.

Location: School locations in the Bronx, Manhattan, Queens, and Brooklyn. See Appendix for full list.

Frequency/Duration: Projects can last from 4 weeks to a full semester; 2–3 days per week; 90 or 180 minutes per week.

Eligibility Criteria: None.

Curriculum: Beam Center brings artists and engineers into public schools to help students create hands-on projects integrating design and technology.

School partnerships can extend school-wide or involve only 1 teacher or a team of instructors across different grade levels. Each partnership begins with at least 2 days of professional development, which includes skills-building around different tech disciplines (making, digital fabrication, physical computing, programming, soft circuits), as well as collaborative planning of the project. Beam Center works with teachers to design a project that incorporates learning goals for a particular unit, or that extends beyond the classroom curriculum.

Computational thinking is emphasized, and projects often incorporate computer science and physical computing, along with crafts like woodworking and metalworking. Brooklyn International High School students, for example, used Python and Arduino to create a digital poetry machine that posts tweets based on magnetic laser-cut words. Fourth graders at Brooklyn School of Inquiry used stop-motion animation and a laser-cutter to reenact the Battle

of Brooklyn. "We're turning a classroom into a production environment," said Matt Robinson, Beam Center's director of school programs.

Outcomes: In addition to school programs, Beam Center offers in-house programs at its Red Hook headquarters, including an annual apprenticeship program for high school students, and workshops for 2nd through 12th graders.

Apprenticeships take a similar approach to school partnerships. They center on projects that incorporate technical skills from a variety of disciplines, from wood and metal work to web and 3D design, fabrication and multimedia production. At the same time, apprentices learn how to design and lead activities and create a club-like atmosphere during youth workshops. Apprentices "come out of that program prepared to work in [Beam's] summer camps or after-school programs," said Robinson. Some of those jobs are funded through SYEP.

Partnerships: DOE

Cost: Free

Sources of funding: Mixed

What makes the program stand out? Beam Center has a goal of developing lasting collaborations with schools. Members of the organization's staff of artists and engineers are often there for each classroom session, helping students and teachers prototype and roll out full projects.

Additionally, by incorporating multiple STEM and creative disciplines into a production-centered approach, Beam Center has been able to reach populations for whom "conventional schooling has become ineffective, and perhaps overly compliance-bound and not responsive to the real world as they experience it," said Cohen.

What does the organization need? More capacity: they can't always take on a school partnership at the moment when a school gets funding for it.

American Museum of Natural History – BridgeUp: STEM

BridgeUp is a STEM program for high school girls that is housed at the American Museum of Natural History involving coursework in coding and a paid internship in scientific research.

Who is served: A diverse group of high school girls, primarily from NYC public high schools lacking access to coding classes and out-of-school learning opportunities.

Number of participants: 40–45

Location: American Museum of Natural History

Frequency/Duration: 120 hours of coursework that can be taken after school during the school year, or during a five-week summer program; nine-month paid internship; annual Hackathons; monthly field trips and workshops around academic and professional opportunities in CS, such as visits to tech companies; optional standalone two-hour workshops.

Eligibility Criteria: They look for students who wouldn't have these types of opportunities in their schools or communities, and who have minimal experience with coding, but have a strong interest in studying science and computer science. Applicants do not necessarily need to live in New York and can begin in grade 9 or 10. 8th grade NYS ELA and math exams/transcript/report card are part of the application, but there are no explicit requirements. Economic status is also considered, with a focus on accepting low-income students.

Curriculum: The first component is 120 hours of coursework centered on coding with Python. Coding is introduced through different scientific disciplines, including the earth sciences, astrophysics and molecular biology. Curriculum relates back to museum exhibitions.

After successful completion, girls can apply for the program's second component, a nine-month paid internship in computational research within one of the museum's scientific divisions. This offers a chance for girls to apply what they've learned about coding in a real-world lab setting and under the guidance of their near-peer mentors (post-baccalaureate women who've majored in CS and science). Throughout the program there are also annual Hackathons with professional developers, and monthly visits to tech companies and science-related academic settings in New York City. Participants can also take standalone two-hour workshops in web development, machine learning, app development and other CS and STEM topics, presented at AMNH by women working in the tech industry.

Outcomes: BridgeUp began only 5 years ago as a pilot program of the museum but has proven effective. As the years progress, participants in BridgeUp tend to become more confident and their interest in science often increases, according to observation-based evaluations and parent surveys. "The change is absolutely amazing. Not only are they learning computational science and programming, but [also] developing their skills through group work, completing a project from start to finish and learning presentation skills," said Yvonne De La Pena, director of BridgeUp: STEM.

Partnerships: None

Cost: Free

Sources of funding: Private

What makes the program stand out? Few programs progress over the course of years, and BridgeUp also has the distinct advantage of being housed in a world-class museum where scientific research is continually underway. Participants are embedded in a professional science setting, and work alongside current STEM majors, bringing them face-to-face with possible career and academic paths to pursue after the program ends.

Coding and computer science, as well as dealing with large data sets and creating data visualizations, have become "essential to research" in the sciences, said Cohen. And in turn, "The girls have become a critical asset to a lot of our scientists." While there's a data science framework around the internship, the participants also have a chance to explore a field they're interested in; typically there are several projects to choose from, and they work in teams of 6 to perform research, analyze data and write code to answer a guiding question.

What does the organization need? Due in part to the success of Bridge Up, AMNH wants to embed CS skills training across its K–12 programs. The museum also sees an opportunity to partner with other institutions to share the BridgeUp framework.

Genesys Works

Genesys Works provides low-income high school students in the Bronx with a 14-month program that combines professional and technical training with paid IT internships and college and career coaching.

Who is served: Rising high school seniors in the Bronx from low-income backgrounds

Number of participants: 30

Location: Out of school: summer program at Pace University. 7 partner Bronx high schools: Alfred E. Smith Career and Technical Education High School, Bronx High School for Law & Community Service (TR), Bronx Leadership Academy II, KAPPA - Knowledge & Power Preparatory Academy International High School (TR), New Visions High School for the Humanities (JFK), New Visions High School for Advanced Mathematics and Science (JFK), West Bronx Academy of the Future (TR)

(TR) = Theodore Roosevelt Campus
(JFK) = John F. Kennedy Campus

Frequency/Duration: 14 months total, starting with 8-week half-day summer training, followed by 20-hour-per-week internships of up to 12 months. Students also receive 60 hours of counseling on college and career pathways, including finding a college match, filling out applications and financial aid forms and applying for scholarships.

Eligibility Criteria: Schools are not charged a fee but must designate a "school champion" who will work a few hours per week as an internal point person for Genesys Works, helping ensure that student interns are still keeping up academically. Genesys Works targets "the quiet middle," or high-potential students in the 75-85 range academically for whom "school hasn't turned on the light bulb," but who are interested in working for a Fortune 1000 company, according to Mike Gross, executive director of Genesys Works New York City. This year, 30 out of 111 applicants were chosen.

Curriculum: The 14-month program begins with 8 weeks of paid, part-time training in the summer before senior year of high school. Participants learn technical skills, with a focus on IT hardware and software, including MS Office/Work/Excel, and professional skills such as public speaking, writing professional emails and the basics of working and socializing in a corporate setting. In the fall, students begin an internship of up to 12 months, often within the IT department of a Genesys Works corporate partner, including tech and non-tech companies such as Warner Media and Salesforce.

As internships progress, students also receive 60 hours of college and career counseling, including finding a college match, filling out applications and financial aid forms, and applying for scholarships. Alumni also get ongoing support as they navigate post-secondary institutions. "We use this experience as a way for them to begin to transform what they think is possible for themselves, see themselves working in a corporate environment and understand what's it going to take to get there," Gross said.

Outcomes: This is the organization's first year in New York, but it has a strong record of success in other urban centers. Among Genesys Works' approximately 4,500 alumni, more than 3 quarters of whom are first-generation college students who qualify for free or reduced price lunch, 100 percent graduated high school, 95 percent have enrolled in college and they're 3.5 times likelier than their peer group to earn a degree. Among employed alumni, at a median age of 24, 46 percent earn the same or more than at least 1 parent and 23 percent earn more than both parents combined.

Partnerships: Companies where interns will be placed this year include: BlankRome, Fried Frank, Kirkland & Ellis, Lazard, Mizuho Americas, Per Scholas, Ropes & Gray, Salesforce, SEO, SMBC (Sumitomo Mitsui Banking Corp), WarnerMedia, Weil, Gotshal.

Cost: Free

Sources of funding: Private

What makes the program stand out? While there are many internship programs in New York, "not a lot

are for high school students, other than SYEP," said Gross, as well as Here to Here, which connects Bronx high school students with paid internships and on-the-job training through the Bronx Private Industry Council and CareerWise New York. Among the available options for high schoolers, Genesys Works stands out for providing intensive professional and technical training, as well as extensive support throughout the program and into post-secondary life.

What do participants need to succeed? It's an intensive program, with a 1,000-hour internship, including 20 hours per week during senior year of high school; participants need to be able to keep up with school work and not lose sight of graduation. "That intensity unleashes student potential, and also allows for really strong mentoring relationships to be built with folks in the workplace, whether a supervisor or someone else," said Gross.

Genesys Works also helps students stay on track by placing advisors in partner schools, as well as "helping them continue to work at the company

where they interned, find other employment in the summer, and nudging them to make sure they're aware of various deadlines," said Gross. There are also gatherings during holiday breaks so students can continue supporting one another.

Participants also need to be paid minimum-wage during the summer training

What does the organization need? Genesys Works has had to compete with SYEP for students, so for the first time it will be paying students for summer training. Gross would like to see a shift to allow for programs like Genesys Works, which provide career-oriented curriculum and work-based experience, to qualify for SYEP. "We don't want [students] to have to make that choice," he said.

DIVAS for Social Justice: STEAM for Social Change + STEAM Camp

DIVAS (Digital Interactive Visual Arts Sciences) for Social Justice offers free social change-focused STEAM programs for underserved K–12 students in Brooklyn and Southeast Queens.

Who is served: Underserved K–12 students in Brooklyn and Southeast Queens

Number of participants: 250

Location: After-school: P.S 156, Laurelton (K–5), The Linden SDA School, Laurelton (Private; PreK–8), The Trey Whitfield School, East New York (Private; PreK–8). Camp: Brooklyn Public Library, Macon Branch

Frequency/Duration: After-school programs: 5 sessions/total of 15–20 hours per week, September–June. Camp: 3–6-weeks, 9 hours per day

Eligibility Criteria: None

Curriculum: After-school and camp program curricula typically center on a yearly community social justice issue, such as gentrification or food access. Students apply the skills they've learned in the fall (or at the start of camp) through a social output project at the end of the program.

Summer campers have learned how gentrification is shaping Bed-Stuy through various STEM-based activities, such as 3D-printing brownstones, and using Google SketchUp 3D software to learn about engineering and design. In other programs, students have worked with a community organizer to create an interactive food justice map of Bed-Stuy, which required interviewing urban growers and mapping areas where healthy food is growing around the neighborhood.

Skills taught include digital media, robotics, animation.

Outcomes: Students can join the organization's other programs: 2 programs focused on media and digital photography, and a newly launched virtual reality mentorship program for high school students at DIVA's new social justice makerspace, Forward, in Bed-Stuy. Forward offers the community use of tools such as computers, sewing machines, VR/AR equipment, 3D printers, videography/photography tools.

Partnerships: NYU, Julia Robinson Math Festival

Cost: Free

Sources of funding: Mixed (DYCD funding for after-school programs; Department of Cultural Affairs)

What makes the program stand out? Few programs integrate community-level social justice issues, which DIVAS centers around. "We want our work to be community solution-based and for [participants] to actually see themselves as being the future leaders of their communities," said founder Clarisa James. Founded in 2011, the organization initially set out to "change the narrative of who was dispensing stories," by training young girls in digital media and IT skills, according to founder James. DIVAS later expanded to include boys and incorporate robotics, 3D printing and other tech skills, because they saw a real need in the neighborhoods where they work, including Bed-Stuy, East New York and Eastern Queens.

Forward, the organization's new social justice maker space in Bed-Stuy, is the culmination of DIVA's efforts since 2007 to raise awareness around tech skills and how they can be applied to solve problems facing underserved communities.

What does the organization need? James insists on hiring instructors from within the community, and finding highly qualified candidates has been difficult due to funding constraints. She does the majority of employee training, but ExpandED has recently provided DIVAS instructors with professional development as well. Instructors are particularly important given that one of James' greatest challenges has been "creating an environment where [students] think it's OK to make mistakes," she said. The programs are often students' first exposure to tech skills, and many are intimidated at first. James also wants there to be less red tape around obtaining equipment/the complicated reimbursement process that comes with some forms of city funding.

HYPOTHEkids: HK Maker Lab

HK Maker Lab is a six-week summer intensive in engineering, design, and entrepreneurship at Columbia University for rising juniors and seniors from underrepresented backgrounds in STEM.

Who is served: Rising juniors and seniors from low-income families and underrepresented backgrounds in STEM.

Number of participants: 23

Location: Columbia University

Frequency/Duration: 30 hours per week, 6 weeks in total

Eligibility Criteria: Applicants must attend a NYC high school during this academic school year (due to the rigor and demands of the program, preference is given to rising juniors and seniors) and demonstrate economic or educational disadvantage. Academic history/attendance record, essays, and letters of recommendation taken into consideration.

Curriculum: Foundations of engineering design curriculum modeled on the senior design class taken by students in the Columbia University School of Engineering and Applied Science. Course is matched to students' abilities, meets Next Generation Science Standards (NGSS) and is taught by a Columbia Engineering program professor.

Students learn the engineering design process, with a focus on biomedical engineering. The process of identifying a problem, doing a needs analysis of potential customers, brainstorming solutions, and building a prototype teaches computational thinking and "instills in them that you will fail if you're trying to do something meaningful," said Christine Kovich, executive director of HYPOTHEkids and co-founder of Harlem Biospace. "It's just a different way of working than they're used to."

Outcomes: Program is tracking students as they begin, and are now completing STEM majors. Teams of students develop a business plan and pitch to biomedical community executives, for the chance to have their design projects incubated at Harlem Biospace.

Partnerships: Harlem Biospace, Columbia University, NIH, Weill Cornell Medicine, West Harlem Development Corp., ConEd, Pinkerton Foundation, NYC Science Research Mentoring Consortium

Cost: Free

Sources of funding: Private

What makes the program stand out? New York City has the largest concentration of academic medical centers in the country. This presents an opportunity to create a diverse pipeline of future biotech industry leaders, and HK Maker Space is among the few programs helping this particular cause.

Working in teams, students identify a health problem and build a biomedical-device solution, such as an automated eyedrop system for glaucoma sufferers. Each team develops a business plan and a pitch, which they present to biomedical community executives, with the chance of their project being selected for incubation at Harlem Biospace, a state-of-the-art biotech incubator. "We're showing students that they can take their STEM skills and apply [them] to solve real-world problems," said Kovich.

What do participants need to succeed? Schools could be doing more to prepare students for post-secondary programs and careers in the life sciences. Feedback from instructors and mentors of Hypothekids programs suggests that "students don't get a good foundation in biology in high school," said Kovich.

The lack of labs and research programs in schools serving low-income students represents another hurdle, and even life sciences-focused schools "have had their research programs falter because they can't find mentors," said Kovich. To help fill that instructional gap, HYPOTHEkids invites public school teachers to "co-learn" alongside students in summer programs, with the goal of having them bring engineering back into their classrooms.

What does the organization need? HYPOTHEkids' capacity is limited by funding and space constraints. It has use of Columbia lab spaces, but Harlem Biospace facilities are typically in use by companies based there. Kovich has also seen huge demand for the limited number of scholarships for elementary school programs (including summer camp).'

TEALS

TEALS (Technology Education and Literacy in Schools) is a Microsoft Philanthropies program that provides high schools with CS education taught by tech-industry volunteers.

Who is served: High school teachers of any subject (and students, to a lesser extent.) TEALS works with both high-performing and high-need schools, public/charter/independent schools

Number of participants: Approximately 40 classrooms served in 2018–19

Location: In school; multiple sites in the Bronx, Manhattan, Brooklyn, Queens.

Frequency/Duration: Varies from one-semester/full-year courses to lab sessions and customized programs to boost AP scores.

Eligibility Criteria: TEALS will work with teachers with at least 2 years of classroom teaching experience. Partner schools are selected largely based on an in-person interview with a TEALS Regional Manager.

Curriculum: The organization provides classroom support for the following curricula in NYC in 2018–19: Intro to CS course that TEALS designed, AP CS A course, AP CS Principles course (versions from both code.org and UC Berkeley). The one-semester Intro course introduces computational thinking through the Snap! visual programming language; an extended version transitions to Python in the second semester. AP Computer Science A is equivalent to a first-semester, college-level course for CS majors, introducing Java as well as fundamental computer science topics such as problem solving.

Outcomes: TEALS does teacher pre/post surveys, an anonymous student pre/post survey, tracks the number of students in each TEALS class, and aggregates AP Score data. The student survey includes awareness and attitudes towards computer science as a discipline and career; their assessment of the TEALS support for their class; and future plans for continuing with computer science. The teacher surveys are focused on teacher comfort with the CS content as well as their experience in the TEALS program.

Partnerships: Microsoft Philanthropies, DOE (TEALS has been serving NYC DOE schools since the 2013-2014

school year, and formally partnered with the CS4All program since the 2018-19 school year), Schools

Cost: free

Sources of funding: Mixed

What makes the program stand out? The organization's reliance on industry volunteers and its tiered levels of support for teachers are unique. The co-teaching model in particular can bring non-CS teachers up to speed in a way that one-off professional development programs may not. "Rather than coming to a workshop for a week, the actual learning is getting to work hand-in-hand with these content experts day in and day out in your own classroom," said Nathaniel Granor, Lead Program Manager, TEALS East Region at the time of this reporting. Additionally, through a new partnership with the DOE, teachers who will be implementing TEALS's intro course in the fall will be required to take a three-day, synchronized online professional development workshop this summer.

What do participants need to succeed? CS4All provides funds to pay teachers for the additional time they spend doing TEALS (such as attending professional development) as well as some expenses related to onboarding volunteers into the schools. Teachers need the "commitment and willingness" to implement the model," said Granor. While many science and math teachers sign on, business, social studies, and art instructors have also participated.

What does the organization need? While TEALS aims to reflect the diversity of New York City in the schools it partners with, that doesn't necessarily include the lowest-performing schools, which probably "don't have the capacity to take on our partnership," said Granor. The time it takes to apply for the program, for example, and having teachers who can commit to it are potential roadblocks to participation. Achieving gender parity among participating students has also proved elusive.

New York Hall of Science, Science Career Ladder/Explainers

The Science Career Ladder Explainers program trains New York City high school and college students to guide visitors through exhibits as well as lead hands-on activities at the New York Hall of Science.

Who is served: For students ages 14–25 (in high school or college). 85 percent of participants are from backgrounds typically underrepresented in STEM, and 60 percent are female.

Number of participants: 165 in 2018

Location: New York Hall of Science (NYSCI)

Frequency/Duration: 2-day orientation. High school students: minimum 5 hours per weekend, with additional shifts during school breaks and summer. College students: minimum of 10 hours on weekdays and up to 20 hours per week. Explainers spend an average of 2.25 years in the program. 1 hour per week of peer-to-peer training

Eligibility Criteria: Currently enrolled in high school or college in New York City; Interest in exploring and learning STEM; Interest in interacting with the public and developing communication skills

Curriculum: Explainers are trained to work in the museum, including explaining exhibits and engaging visitors and younger students, as well as leading hands-on activities. "Their main purpose is to bring the science to life and make it relatable," said Priya Mohabir, director of the Alan J. Friedman Center for the Development of Young Scientists at NYSCI. There's a lot of breaking down complex ideas; "Rather than talking about the refractive index of various mediums and how that changes over time, you might talk about how light bends through a certain object through different times of the day," said Mohabir.

Students don't necessarily learn how to code (though there have been coding workshops for some cohorts), but rather, "It's really thinking about technology, not just as a career pathway, but technology as a skillset that you need for any aspect of a STEM career." For example, NYSCI has hosted engineering career nights for Explainers with discussions around "the role that technology and coding skills play in how [engineers] are designing new software or workflows."

Skills: communication skills, scientific process, teaching and communicating science.

Outcomes: Many students go on to major in STEM fields in college; in the program's 33-year existence, 95 percent of participants have gone on to college, with 70 percent majoring in STEM.

Mohabir also emphasizes that 89% of alumni are using the communication and presentation skills and scientific literacy skills that they gained through the program in their academic lives and in their careers. Explainer Trainees can move up to become senior Explainers as well.

Partnerships: CUNY's Accelerated Study in Associate Programs (ASAP), Internationals Network for Public Schools, Young Adult Borough Centers, Kingsborough Community College, Hostos Community College.

Cost: Free; participants are paid minimum wage

Sources of funding: Private

What makes the program stand out? While many Science Career Ladder participants go on to pursue STEM in college and beyond, the program's emphasis is on "how STEM literacy makes you a more active citizen" and a more capable decision-maker in multiple sectors, said Mohabir. The rounded approach reflects efforts across NYSCI to prioritize active engagement with families in surrounding neighborhoods, which are made up largely of recent immigrants. The museum offers free STEM workshops for local parents, for example, and hosted a conference on STEM as an opportunity pathway for first-generation families. This is the environment in which Explainers are immersed.

The program also supports a vast alumni network, and Explainers participate in various professional development and career exploration opportunities, from events with STEM internship providers and nonprofit providers of STEM programs (like Girls Who Code and All Star Code) to field trips to tech companies to events where university leaders describe the different

CREDIT: Photo by Andrew Kelly/NY Hall of Science

STEM majors they offer. Participants also engage in weekly peer-to-peer training with Senior Explainers in science content, and communication and presentation skills. "We're trying to become a support system for a community of people who might have some hurdles to face as they move forward in their academic and career lives. Building this as a community has been really helpful [for participants] just to fall back on," Mohabir said.

What does the organization need? NYSCI is not looking to expand the size of the 100-person program because it wants to maintain "the one-on-one attention and the sense of community," said Mohabir. She would like to extend career exploration workshops to a broader range of students but funding is a challenge, in part because Explainer doesn't qualify for inclusion in SYEP (because students stay for years, not weeks), "although this work is directly contributing to the development of students that live in the city," she said. Mohabir would like to see more city funding, specifically from DYCD, directed toward non-city agencies, particularly cultural organizations that are focused on youth.

How is computational thinking integrated into the program? New York Hall of Science has also become a leader in developing K–12 and professional development programs that integrate computational thinking, including through a partnership with Robin Hood. An app called The Pack, for example, created by NYSCI and Design I/O with input from middle and high school teachers, combines environmental systems and computational thinking concepts. Designed for classroom or home use, the digital game prompts students to test and revise algorithms by, for instance, having them combine game functions (such as holding and digging for food sources) in a computational sequence (an algorithm). Explainers help lead NYSCI programs for younger students that involve computational thinking, such as in the Maker Space, "so they have an opportunity to learn a new content area, but also be role models or near peer mentors for those students in the program," said Mohabir.

New York on Tech: TechFlex Leaders/360 Squad

New York on Tech is a nonprofit that provides free computer science and technology classes as well as mentorship and internship opportunities for low-income high school students of color.

Who is served: Students in grades 10—12 from schools throughout the city where at least 50 percent of the population is eligible for free and reduced price lunch. Majority of participants are Black and Latinx.

Location: In and out of school; multiple companies, community organizations and schools in all 5 boroughs

Frequency/Duration: Tech 360 Squad: fall and spring sessions each run for 10 weeks, once or twice per week in person plus 2 hours in additional homework/coursework; Tech Flex Leaders: September–June, every Saturday for 5 hours.

Eligibility Criteria: Tech 360 Squad: 10th or 11th grader in a NYC high school who is interested in careers in web design/computer science/technology, and able to demonstrate dedication, passion and leadership. Tech Flex Leaders: 10th or 11th grader in a NYC high school at the time of application who is interested in careers in computer science/technology, available for workshops after school or on weekends once per week during school year, eligible for free or reduced price lunch, and able to demonstrate dedication, passion and leadership

Curriculum: Tech Flex Leaders: CSTA- and Common Core-aligned curriculum created by New York on Tech. Students learn front- and back-end web development skills and create portfolios of technology projects. Tech 360 Squad: fundamentals of web design and development; available tracks include web development, web design and mobile development; cyber security, data and product-focused tracks will be rolling out next year. Core skills: Front-end and back-end web development skills (coding, database administration, accessibility, and security compliance). Coding languages taught include HTML, Javascript, Python, Ruby, and ReactJS.

Outcomes: Students leave the program with a portfolio of technology projects they've created and have the opportunity to apply for internships with the companies they've been embedded in. Tech 360 Squad alumni have priority eligibility into Tech Flex Leaders program.

Partnerships: General Assembly, Teach for America, Girl Scouts, Google, Morgan Stanley, Vodafone, Facebook, Consensys

Cost: Free

Sources of funding: Private

What makes the program stand out? "We really see ourselves as like a General Assembly, but a nonprofit model," said co-founder Jessica Santana. Participants in both Tech Flex Leaders and 360 Squad are embedded in tech companies around the city, and as a result they come away well positioned for internships and careers.

Tech 360 Squad cohorts meet once or twice weekly at partner companies for a course in the fundamentals of web design and development taught by a tech-industry professional. Participants have priority admission to Tech Flex Leaders, a CS-focused nine-month program in which students take classes at tech companies and are also mentored by company employees, with the opportunity to apply for internships.

New York on Tech also runs similar programs in high schools across the 5 boroughs, but mainly in the Bronx and Manhattan. "Schools choose which track of the curriculum they want us to teach to their students," said Santana. The organization does the same for community-based organizations, like the Girl Scouts, that want to incorporate computer science into their programming.

What do participants need to succeed? Active mentorship within tech companies, and help overcoming overcome imposter syndrome.

What does the organization need? "Every year, we have to turn students away, and not because they don't meet our criteria. We just don't have the capacity," said Santana. "If we had the funding we could reach as many students as we want."

New York Academy of Sciences: Scientist-in-Residence

The Scientist-in-Residence Fellowship Program pairs scientists with science teachers in underserved K–12 schools to develop and implement long-term research projects in the classroom.

Who is served: K–12 teachers and students in underserved schools (with a focus on middle school) in Brooklyn, Manhattan, and Queens

Number of participants: Roughly 335 students

Location: 7 in-school locations in Brooklyn, Manhattan, and Queens: MS442 Carroll Gardens School for Innovation, PS142 Amalia Castro, Institute for Collaborative Education, High School for Health Professions and Human Service, Teachers College Community School, The Queens School of Inquiry, Expeditionary Learning School for Community Leaders

Frequency/Duration: 10 sessions (at least every 2 weeks per semester) of 45 to 60 minutes. A scientist might support 2–4 classes at each school.

Curriculum: Research project developed by teacher and scientist and aligned with NGSS curriculum standards. Middle school teachers typically propose life sciences research, while elementary school teachers take a STEAM approach; last year, a third-grade class used clay to represent different layers of skin during a biology research project, for example.

Outcomes: Students can go on to other NYAS programs, such as Junior Academy. NYAS is working on creating a teaching credential for scientists who complete the program. Pre- and post-program surveys measure teachers' comfort level with implementing STEM projects after the program; whether teachers see any improvement in students' skill and knowledge. For scientists, NYAS measures interest in becoming a science educator and skills in pedagogy, communication, and collaboration.

Partnerships: DOE, schools listed above

Cost: Free

Sources of funding: Mixed; The program was created in partnership with DOE, but moving forward NYAS will be "running the program more independently" according to program manager Rowena Kuo.

What makes the program stand out? The program targets underserved schools identified by DYCD and aims to give students an opportunity to conduct long-term, authentic scientific research, as well as expose teachers to computer science techniques while preparing them to carry out independent research projects. Teachers propose a research project and NYAS then seeks out scientists with backgrounds in that particular field, often graduate or undergraduate students interested in teaching.

Additionally, NYAS encourages teachers and scientists-in-residence to develop their projects around improving students' communication, collaboration, and critical thinking skills. Digital literacy is another major component, said Kuo, as students gain experience with "how to critically evaluate the resources that they find online." In doing so, students get the rare opportunity to learn directly from scientists, who share the vetting methods they use when conducting their own research.

What do participants need to succeed? Teachers need help preparing students for the 8th-grade NYS science test. For that reason, NYAS plans to shift the focus of Scientist-in-Residence towards middle schools this coming year. Because of the lack of science instruction at the elementary level, Scientist-in-Residence can help provide the "catching up" that many middle school students need, according to Kuo. And whereas in previous years the DOE recruited teachers while NYAS recruited scientists, NYAS will be doing both for the coming school year in an effort to better align teacher needs with scientists' expertise.

What does the organization need? There are always more teachers wanting to be part of the program than there are scientists available to lead classes. NYAS needs more scientists to be part of this program, as well as resources to help with aligning curriculum to scientists' expertise. More buy-in from schools, including more support for teachers who want to or are participating in Scientist-in-Residence, is another need.

Global Kids: Digital Learning & Leadership

Digital Learning & Leadership (DLL) is an after-school program that exposes undeserved K–12 students throughout New York City to real-life applications of STEM learning.

Who is served: Underserved K–12 students throughout New York City

Number of participants: Roughly 2000

Location: In school/after school: Bronx Studio School for Writers and Artists, Bronxdale High School, Careers in Sports High School, Curtis High School, High School for Global Citizenship, High School for Medical Professions, High School for Public Service, High School of Art and Design, International High School at Union Square, John Adams High School, Manhattan East School for Arts & Academics, Renaissance Charter School, P.S./I.S.109, P.S. 96, School for Human Rights, Transit Tech Career and Technical Education High School, The 30th Avenue School (Q300), Washington Heights Expeditionary Learning School (WHEELS), William Cullen Bryant High School

Frequency/Duration: 1 to 2 sessions per week throughout the school year

Curriculum: The culturally inclusive curriculum draws on the CS4All Blueprint, and centers on building 21st-century skills, particularly leadership. Students may work on game or graphic design, audio or video production, 3D technologies, or virtual reality, always with a connection to a global issue and often with local relevance. Because Global Kids staff are embedded in schools, they can adjust the DLL curriculum to meet each school's unique needs, whether that means introducing new skills or supplementing ongoing coursework.

Outcomes: Students leave with both hard and soft skills. "We're not exclusively talking about tech skills. We're talking about how you use and produce digital media; how you engage in public speaking and participate in policy advocacy using those skills as well," said Elizabeth Bishop, director of curriculum & outcomes evaluation and supervisor of DLL.

Because of GK's involvement with The Hive, a consortium of STEM program providers in New York City, it can guide students toward other nonprofit providers of STEM programs and internships.

Partnerships: DOE, The Hive

Cost: Free

Sources of funding: Mixed

What makes the program stand out? The organization's focus on cultivating global citizenship results in unique project-based work that allows participants to learn tech skills while addressing problems or questions in their own communities. Through a partnership with LinkNYC, for example, students used graphic design software to create murals about STEM innovators who were women of color from New York City, which were projected on LinkNYC screens for Women's History Month. Through an upcoming partnership with ICCROM, an international cultural heritage preservation organization, students at William Cullen Bryant High School in Long Island City will use Tinkercad (3D design software) to research destroyed UNESCO World Heritage Sites and then identify sites around New York City that they feel are worthy of similar preservation and care.

What do participants need to succeed? Bridges to maintain their engagement in digital skills and STEM during the transitions between middle and high school, high school and post-secondary, and into careers.

What does the organization need? DLL could be more effective if all schools had consistent access to high-speed Internet. Other challenges include figuring out how best to introduce soft skills to very young students, and how to broker opportunities for young people when they're changing schools or transitioning to middle or high school. The organization also needs more investment from the city and consistent funding, as well as better connections within the STEM ecosystem.

Consortium for Research & Robotics (CRR)

The Consortium for Research & Robotics provides free STEM education for K–12 students incorporating industrial robotics and other digital manufacturing technologies.

Who is served: Black and Latinx students from underserved communities. While the focus is grades 7–12, 4th and 5th graders have also participated in recent programs.

Number of participants: 200; 10–30 per cohort

Location: Out of school: CRR, Brooklyn Navy Yard; Red Hook Initiative, Red Hook. In school: PS 686 Brooklyn School of Inquiry, Bronx School of Inquiry, Dock Street School, Children of Promise, Brooklyn Democracy Academy, and Susan S. McKinney Secondary School of the Arts.

Frequency/Duration: Varies from weekly to monthly. From 3 days per week for 3 weeks in the summer program to 10 one-hour sessions over the course of a semester.

Eligibility Criteria: For state-funded STEP program, eligible students receive free and reduced price lunch, or come from historically underserved communities. For privately funded STEM program, they work directly with schools, which select the participants.

Curriculum: Project-based curriculum focused on using analog and digital tools to create something with scalable, real-world applications. Skills taught: CAD, laser-cutting , 3D printing, robotics, and soft skills including presentation, critical thinking, and how to communicate decision-making.

The largest program consists of 5 modules beginning with a visit to the Consortium and followed by in-school sessions led by a researcher. Students first learn how to approach problem solving before brainstorming ideas for projects with real-world implications; previous groups have created rip-rap to prevent flooding along the Gowanus Canal. Students take an analog approach first, such as graphing, and then learn and transition into using digital tools that allow for scalability, such as 3D CAD software and laser-cutting. During the final session, held at the Consortium, projects are automated; students "can see how the math is a code that the robot can read, and then make big. It's an amplification of

their agency," said founder Mark Parsons.

Outcomes: Students return to school with a sign about their project, created using Consortium technologies, to present to their peers and faculty.

Partnerships: Pratt, New Lab. Schools: PS 686 Brooklyn School of Inquiry, Bronx School of Inquiry, Dock Street School, Children of Promise. Schools, in partnership with New Lab: Brooklyn Democracy Academy, Red Hook Initiative - Digital Stewards, Brooklyn Democracy Academy, Susan S. McKinney Secondary School of the Arts

Cost: Free

Sources of funding: Mixed (some private and public schools and community groups pay for the STEM programs, while other funding comes from NYS Science Technology Entry Program (STEP), for Title I schools)

What makes the program stand out? Across all programs, students learn CAD and a variety of digital manufacturing technologies, as well as "soft skills around the technology." That combination of hard and soft skills, and the impressive technologies available at the Consortium, make its programs stand out. It's rare for students to not only see but participate in a functioning industrial space that uses cutting-edge technology. Moreover, students interact with researchers and are exposed to a mix of tech professionals, artists and academics, ultimately giving them a sense of belonging, according to Parsons. "They are proud of their work and feel like this space is a place where they belong and are contributing."

What do participants need to succeed? A feeling of belonging in a tech-focused, professional space.

What does the organization need? Funding in general, as well as for a full-time STEM program coordinator.

CodeScty

CodeScty has developed curriculum that uses original hip hop music and videos to teach foundational computer science to diverse communities.

Who is served: Diverse communities; mainly middle and high school students, some elementary

Location: They've piloted with schools and organizations including Google Code Next, Atlanta Public Schools, PS33 in NYC, DreamYard, All Star Code, New Rochelle High School, Monroe College, Pier55

Frequency/Duration: The lessons are customizable for different age groups and durations of time.

Eligibility Criteria: The organization is focused on working with communities of color and students from underrepresented backgrounds in STEM.

Curriculum: Music-based curriculum uses original hip hop songs and videos to teach foundational computer science. The company has carried out successful pilot projects in New York City public schools using this approach, always with an emphasis on pre-coding concepts and culturally relevant real-world applications. Skills taught: computational thinking, innovator mindset, standards in the CS4All Blueprint

Partnerships: NYU Steinhardt, SXSW, Google Code Next, Pier55, DreamYard, #YesWeCode, All Star Code, NEW INC, Startup Leadership Program, 4.0 Schools, Idea New Rochelle

Cost: Free for students.

Sources of funding: Private

What makes the program stand out? Code Scty's approach of teaching tech skills and computational thinking through a culturally relevant lens is powerful. But what also sets the organization apart is its emphasis on empowering students to be creators of technology, largely through giving students a theoretical foundation that will set them up to succeed in coding.

The curriculum helps students "to understand complexity and engage in solutions that they can develop in their community," said co-founder Armando Somoza, who comes from a nonprofit arts background and has taught web development and coding. "We're teaching engagement and fun and entrepreneurship and innovation skills," which sets students up "to be creators of technology," he said.

Lessons use aspects of youth and pop culture, such as viral dance challenges, to teach algorithms. Students might deconstruct a dance into steps and sequences, or consider what problem an artist is trying to solve by creating a song. They could also use design thinking to identify a problem in their community, and create their own dance challenges with steps and sequences that can be translated through code.

What do participants need to succeed? For teachers to be more open to incorporating nontraditional curricula into their classrooms. Code Scty also offers professional development for teachers who want to use its curriculum, and the organization is working toward distributing their content to nonprofits, schools, and museums. "The idea is to help them cast a wider net and engage more young people into their pipeline," said Somoza.

What does the organization need? In addition to funding, one challenge Code Scty has faced is that many technical teachers studied computer science and teach as way they were taught. "It perpetuates a very specific cycle; most aren't trained in pedagogy, and that isolates and excludes so many people," Somoza said.

They've experienced resistance to their approach among some in academia and computer science. But once skeptics experience a pilot, and see students get excited about the concepts behind "lofty technical jargon" such as algorithm and abstraction, they tend to change their minds, according to Somoza.

Cooper Union STEM Saturdays

STEM Saturdays is a hands-on engineering and design program for high school students from underrepresented backgrounds in STEM.

Who is served: High school students from underrepresented backgrounds in STEM. Students are typically high-achieving academically and "come in interested in creative problem solving," said Elizabeth Waters, associate director of STEM Outreach for Cooper Union's Albert Nerken School of Engineering.

Number of participants: 24 per cohort

Location: Cooper Union

Frequency/Duration: 1 session per week, 6 hours per session, for 11 weeks; fall and spring cohorts.

Eligibility Criteria: No prior experience is required. The program seeks to include students from all 5 boroughs and from groups that are underrepresented in STEM.

Curriculum: Project-based engineering design curriculum that teaches students to use computer-aided engineering tools as well as engineering design and rapid prototyping techniques to solve a real-world problem. Skills taught: design thinking, collaboration, presentation skills, and computational thinking. Students use design software such as Arduino, CAD, Onshape, and microcontroller programing, and employ 3D printers, laser cutters and hand tools. "We're not teaching anything to mastery, but to sufficiency. The goal is for them to see what each of those [tools] can do, so that they can imagine how to implement it in their project," said Waters.

Outcomes: Referrals to other STEM programs such as Intrepid Museum, AMNH, Rockefeller Neuroscience Program. College and career counseling sessions with Cooper Union staff. Student team that wins the final presentation receives a cash prize. The program aims to springboard participants into Cooper Union's competitive Summer STEM program, which accepts up to about 50 high school students. Cooper Union's incoming undergraduate engineering class is between 110-120 students; in 2018, about 45 participants of K–12 programs applied, and up to 10 percent of participants are on track to apply this year. Participants have also gone on to work as instructors for other CU K–12 STEM programs.

Partnerships: Cooper Union

Cost: Free, and students receive Metrocards and lunch.

Sources of funding: Private

What makes the program stand out? Many students have accepted the idea that coding is an essential skill, but perhaps fewer grasp the importance of honing softer skills around technology. STEM Saturdays is also one of just a handful of programs that foreground design thinking. "We want [students] to be fantastic designers and problem solvers, because from our point of view, [those] are the harder skills to learn," said Waters.

Working within the theme of "Technology for Good", students work in small teams to design and build a product to solve a current or emerging problem. Participants are also mentored by Cooper Union students in areas such as professional skills, from technical communication to teamwork, design thinking and giving presentations.

What do participants need to succeed? More mentors from diverse backgrounds. Participants pitch their product ideas to a panel of judges for the chance to win a cash prize; judges are typically people from the local community, of diverse backgrounds and ethnicities and working in engineering education or creative tech fields. "When we look for judges, we are usually looking for people who look like our students, so it's another opportunity for them to be exposed to role models," said Waters. However, she said, when it comes to mentors, because Cooper Union is largely Asian and white, "there's a mismatch in what our mentors look like [in comparison to participants]."

What does the organization need? There's a high demand for Cooper Union's K–5 programming, but not enough space to accommodate demand. Waters would like to see more blended learning spaces for K–5 students that could also be open to the community. "We don't always need to have 3D printers or laser cutters in order to teach kids how to do fabrication and work through the thinking involved in that, but sometimes we need space for students to use box cutters safely or to drill something," she said.

iMentor

iMentor pairs mentors who are professionals in tech and other fields with high school students from low-income immigrant communities for a minimum of 3 years.

Who is served: Students attending high schools in underserved communities where a majority of students would be first-generation college students

Number of Participants: 3,563 mentor-mentee pairs

Location: In school: Marble Hill School for International Studies; Bronx Academy for Software Engineering; Bronx High School for Law and Community Service; Comp Sci High; Bronx Leadership Academy II; The Laboratory School of Finance and Technology; Frederick Douglas Academy II; Business of Sports School; Academy for Software Engineering; Urban Assembly School of Business for Young Women; Lyons Community High School at Lafayette; High School for Service and Learning; International High School at Lafayette.

Frequency/Duration: 1 class per week; 1 meeting per month; weekly online check-in; 3 to 4 years in total.

Eligibility Criteria: Mentors must commit to helping a high school student get into college; connecting online with mentee once a week; and meeting in person once a month.

Curriculum: The weekly class that participants take combines social-emotional skills with college preparation. Skills taught include growth mindset, setting goals, and building relationships.

Outcomes: Compared with non-partner DOE schools with similar demographics, iMentor partner schools have a 20 percent higher college attendance rate, and mentees are 25 percent more persistent than non-mentees after 1 year of participation.

Partnerships: Citi Foundation, Morgan Stanley, PWC, AT&T Foundation, BlackRock, AlphaSights Barclays, Bloomberg Philanthropies, Allen & Company, Capital One, Credit Suisse, Deutsche Bank, DTCC, Equinix, Ernst & Young, EXL Service, First Eagle Investment Management, Goldman Sachs, HSBC, Macy's, The Nielsen Foundation, UBS)

Cost: Free

Sources of funding: Private

What makes the program stand out? iMentor stands out for embedding in schools and guiding mentees on a regular basis, whether they need help applying for and financing college or want internship experience in the tech industry.

When iMentor partners with a high school, every student in that school gets a mentor. There are 2 models: beginning in 9th grade and continuing through 12th grade, or starting in 11th grade and lasting through the first post-secondary year. iMentor also places a full-time program manager in each school to teach a weekly class, supervise monthly mentor-mentee events, and provide general and college counseling.

Matching is driven primarily by the student's interests and preferences. In most cases, if a student desires a mentor who works in tech, that can be accommodated. iMentor has brought on mentors from Google and various startups, according to the New York office's executive director, Max Polaner.

What do participants need to succeed? iMentor has learned that, when it comes to mentoring, "the more structure you provide, the better it works," said Polaner. iMentor provides content for mentors to draw from during monthly in-person meetings and weekly online check-ins with mentees. Mentors are also provided with resources to help them understand the city's post-secondary landscape, and build relationships with students across different backgrounds. Nationwide, 42 percent of the organization's mentors identify as people of color and 28 percent are first-generation college students, compared with 94 and 65 percent of student mentees, respectively.

What does the organization need? While iMentor is the second largest mentoring organization in New York City after Big Brothers Big Sisters (an iMentor partner in other cities and states), Polaner sees room to grow. Financial obstacles stand in the way; partner schools pay a portion of the program's $1,200-per-student annual cost. iMentor raises the remainder of funding and would like to see more support from the city.

Citizen Schools: Apprenticeships

Citizen Schools places community volunteers in underserved middle schools to teach a variety of STEM subjects using hands-on activities and emphasizing social and emotional skills.

Who is served: Middle school students from underserved communities; more than 90 percent of students are eligible for free or reduced price lunch.

Number of Participants: 350

Location: After school: Renaissance School of the Arts (Manhattan, East Harlem), Isaac Newton Middle School for Math & Science (Manhattan, East Harlem), Urban Assembly Unison School (Brooklyn, Clinton Hill), P.S. 157 Benjamin Franklin Health & Science Academy (Brooklyn, Bedford-Stuyvesant)

Frequency/Duration: One 90-minute session per week for 10 weeks

Eligibility Criteria: Students attending partner schools

Curriculum: Volunteer teachers from the community lead 10-week courses using curricula and lesson plans provided by Citizen Schools. About half of the courses are in STEM subjects, including electrical engineering, solar cars, robotics, coding with CSS and HTML, and design thinking. Lessons involve hands-on activities and emphasize social and emotional skills, growth mindset and collaboration. Volunteer teachers pitch their apprenticeships to students at the start of fall and spring semesters, and students can choose to take up to 4 classes in 3 different topics over the course of the school year. An Americorps member with an interest in teaching helps volunteer teachers lead each lesson. Skills taught include social and emotional skills, growth mindset, teamwork, and collaboration. STEM subjects might also emphasize additional core skills such as coding, design thinking, and engineering.

Outcomes: Citizen Schools does pre- and post-program surveys of students' social emotional skills. They are beginning to track how the program connects to high school and beyond, including students' interest in STEM careers, where students go on to high school, and how likely they are to go on to major in STEM in college. 8th graders can apply for Coding Academy, a year-long program in which students are paired with an engineer from a corporate partner (Amazon, Capital One, and Google). Students meet with their volunteer coach at the coach's corporate office every other week. The program includes mentorship and one-on-one instruction in coding with Python, for example, or video game design, based on the student's skill set.

Partnerships: Amazon, Capital One, Google

Cost: Free

Sources of funding: Mixed (DYCD foundations, and corporate partners)

What makes the program stand out? Computer science is not offered at any of the organization's 4 partner schools in New York City, and with few nonprofit STEM programs focusing their efforts in Bed-Stuy and East Harlem, the apprenticeship may be the only opportunity for some students attending those schools to be exposed to CS or STEM. Discovering an interest in STEM in middle school can "kind of switch their brain into like, 'here's something I'm passionate about and I really want to go towards,'" said Nadia K. Selby, Executive Director for Citizen Schools New York. "If we can spark the interest of science and technology early on, they'll be more likely to pick a high school that will further that development."

Volunteers typically work in the field that they teach—Google engineers and Girls Who Code employees have taught apprenticeships—showing participants that they can, for example, "sit behind a computer and design a video game," as their career, said Selby. Most important are the connections participants begin to make between what they're learning in school and what they can someday do for a living. "That's what's helpful," Selby said.

What do participants need to succeed? The organization puts an emphasis on building participants' social emotional skills, using pre- and post-program surveys of students and employees created by the Student Success Network to uncover gap areas every year. Growth mindset (how to persist) and self-awareness (particularly in connecting with classmates) have emerged as social-emotional challenges among students, and focus areas for the organization, according to Selby, before students get to high school and college.

What does the organization need? 3 out of 4 after-school apprenticeship programs are DYCD-funded, while the fourth receives City Council funds, but Citizen Schools needs more funding or DYCD contracts in order to expand. "The schools themselves do not have additional funds to set aside to run an after-school program for us, so if you do find schools that really love our program and love what we offer, we also have to have the contract," said Selby. "A hiccup that we're facing, it's just how do we go into the school that doesn't have enough in their budget to pay for us to support the work? There's but so many DYCD contracts available for us to apply for."

Greater awareness among larger STEM organizations as well as tech companies could also give Citizen Schools a boost. "I'd like to see more folks in schools so that they can see what students are doing and learning," Selby said. "I think that's the gap, not necessarily seeing how it's impacting children." The organization has previously partnered with Google and Girls Who Code for apprenticeships. Potential partners benefit from the fact that Citizen Schools already "have the 'in' working with students," while students learn of additional opportunities around STEM, like Saturday programs or summer camps.

STEM Kids NYC -- In School and After School Programs

STEM Kids NYC takes a hands-on, culturally responsive approach to teaching K–5 students computer science and STEM.

Who is served: K–5 students

Number of participants: 225 (includes all in-school and after school programs)

Location: 11 schools and 2 community centers in Brooklyn (Red Hook, Park Slope, Bay Ridge, Brownsville, Bushwick) and Manhattan (Washington Heights, Inwood, Harlem, Upper West Side, Midtown, Governors Island)

Frequency/Duration: After school: 2–5 sessions per week, 1–3 hours each, September–June. In school: treated as residencies (a DOE term) and are generally 1 day per week over a span of multiple weeks, based on a school's budget allocation.

Eligibility Criteria: The organization tries to provide 2 teachers for every 15 students; schools must be able to limit the number of students in the session to maintain that ratio.

Curriculum: STEMKidsNYC teaches STEM and computer science through a hands-on, learning-by-doing approach, with an emphasis on meeting students where they are and culturally responsive teaching. Topic areas include computer science, engineering, robotics, and creative technologies (Micro:bit, Arduino, Makey Makey, virtual/augmented reality). Lessons are aligned with the CSTA K–12 CS Standards. Students build critical thinking skills by regularly answering the question of "why" they are doing a particular activity. Computational thinking is also integrated into lessons.

Outcomes: Students have the option of joining STEMKidsNYC's STEM summer program for grades K–10.

Partnerships: The organization partners with several schools in Brooklyn and Manhattan, as well as 2 community-based organizations in Manhattan, but would rather not name them publicly.

Cost: Families sometimes pay, based on a sliding scale.

Sources of funding: Schools, families (sliding scale), STEM Kids NYC subsidizes through corporate donations it receives. No city funding.

What makes the program stand out? STEMKidsNYC puts a focus on teaching K–5 students computational and critical thinking skills. "If we don't ask students 'why', if we haven't had them take a minute to write down why [they] think it's happening, then we aren't helping them build their own critical thinking skills," said founder Yvonne Thevenot, an Arthur Zankel Fellow at Columbia Teachers College, where she is researching and developing culturally responsive curriculum that utilizes a STEM interdisciplinary approach to teaching and learning. She builds lessons around "how a child would like to play," and strives to bring a tech mentality into the school day, encouraging students to be "self-directed [because] if you're at a tech company, you need to get up and make it happen." This is not the approach taken in most classrooms. "Tech still tends to be a separate construct to teaching and learning," said Thevenot.

The organization's focus on culturally relevant curricula is also uncommon among nonprofit STEM programs targeting younger students. "All teaching and learning can be modified to respond to the children in front of you," said Thevenot. "It's not just [students'] ethnicities; it's people's ideology, it's the culture of the school," that should help determine how a lesson is taught. Thevenot requires that her teachers find and present to students "cultural icons who reflect their culture" and who are working in STEM.

What do participants need to succeed? Thevenot said that students need to be able to attend the in- or after-school program 5 days a week, for at least 1 hour per day, but that more funding is needed to make this possible. Most schools' budgets don't allow for such a schedule.

What does the organization need? Funding, participation in TechNYC, and better access to the DOE and CS4All so that the organization can share its culturally responsive STEM curriculum more widely.

Rocking the Boat

Rocking the Boat offers middle and high school students hands-on, inquiry-based activities that explore Bronx River ecosystems and ecology, with opportunities to become paid environmental apprentices.

Who is served: On-water classroom: middle and high school students from throughout the city. Long-term partner middle and transfer-high schools in the South Bronx.

Number of Participants: Roughly 5,000

Location: In school at Fannie Lou Hamer Freedom High School. After school at Rocking the Boat (programs on and around the Bronx River).

Frequency/Duration: Field trips of 2-3 hours, extended learning for partner schools

Eligibility Criteria: None

Curriculum: STEM curriculum centering on Bronx River ecosystems and ecology. Schools can choose from several different activities that connect back to what students are doing in the classroom. Hands-on activities focus on particular organisms, such as birds, fish, oysters and plankton. Students use basic lab equipment, and engage in data collection, such as measuring oyster growth and identifying companion species. A water-quality monitoring program has students explore human impacts on the Bronx River through testing salinity, PH, and dissolved oxygen.

Outcomes: 11th and 12th graders can apply to become paid apprentices through Rocking the Boat's contract with the Bronx River Alliance. The environmental apprenticeship, part of Rocking the Boat's youth development programs, has students working with professionals in the field, using scientific instruments to collect bacterial samples from the Bronx River, building and monitoring suspended wetlands, and surveying shore and wading birds for the City Audubon Society. "One of our goals for middle school programs is to develop a pipeline into our youth development program. We have social workers on staff that work closely with each student, give them tutors, and [counsel them about] scholarships and college admission," said public programs director Sarah Miles.
Instructors of public programs have often grown up through the organization. "They're college students who went through it and have been trained within all of our programs, so they bring a range of different skills and knowledge," said Miles.

Partnerships: NYC Parks, Bronx River Alliance, Bronx schools: Bronx Alliance Middle School, Fannie Lou Hamer Freedom High School, St Ignatius School (middle school), Bronx Arena High School (transfer high school), Jill Chaifetz Transfer High School.

Cost: Schools pay for field trips. Partner school programs are grant-funded.

Sources of funding: Public programs are privately funded. Youth development programs are largely funded by DYCD.

What makes the program stand out? Connecting classroom work to real-world applications of environmental science can incite students' interest in STEM. But the Bronx setting makes these programs especially powerful. "We have kids who are nervous, in tears, screaming when the boat starts to rock, and then high fiving" by the end of the program, said Miles. And that opens the door to more in-depth STEM learning. Students might wade into the Bronx River to collect plankton samples to examine back in the lab, revealing "all these organisms that were unknown [to them] in the river right here," said Miles.

What does the organization need? "A lot of our Title I schools have limited resources to spend on field trips," said Miles. Rocking the Boat is located in the "very industrialized and very underserved" Hunts Point area, and the organization provides youth development apprenticeship programs at no cost to kids. But Miles would love to be able to fund more out of school opportunities for schools in the surrounding community.

NYU Tandon: Innovative Technology Experiences for Students and Teachers

ITEST is a professional development program for high school science and math teachers that involves students and culminates with teachers creating a robotics elective at their school.

Who is served: NYC high school science and math teachers and high school students from 8 high schools around the city. Targets schools in underserved neighborhoods with diverse student bodies.

Number of Participants: 16 teachers and 32 students

Location: NYU Tandon School of Engineering

Frequency/Duration: 5 Sessions/42.5 hours a week for 4 weeks in July, 2 meetings per semester. During school year: implement elective robotics class and participate with students in a robot product design and business idea competition.

Eligibility Criteria: Two certified math, science, or CTE teachers from the same NYC high school apply as a pair, though single applications are also accepted. Teachers should have 3 years of full-time teaching experience, endorsement from the principle, and be able to teach a robotics course the following year. Each teacher selects 2 high school students from their school.

Curriculum: ITEST is a professional development program for New York City high school science and math teachers, who attend along with 2 students from their high school.

The four-week summer training program follows a NGSS-aligned curriculum developed by NYU Tandon's mechatronics lab. Teachers and their students work alongside each other to design and build a working robot, while learning engineering design practices. They return to school with access to the full curriculum and robotics kits. The curriculum is hands-on and project-based, and teaches students to put science and math concepts to use through robotics and entrepreneurship activities. Students who attend the summer course typically become assistant teachers or mentors to their classmates during the robotics elective throughout the school year.

Outcomes: An elective course for at least 24 students combining robotics and entrepreneurship becomes available at high schools around the city. Teachers leave with a stronger support network of colleagues trained to teach the science and math behind robotics. During spring semester, school teams compete in a robot product design and business idea challenge. The winners may be offered internships (this past year, winners were offered internships with Silicon Harlem).

Partnerships: National Science Foundation. This year featured a partnership with Silicon Harlem.

Cost: Free, and project participants who successfully complete all requirements will receive a stipend of $3,750. Student participants receive $500.

Sources of funding: Private (National Science Foundation)

What makes the program stand out? ITEST is a unique professional development program because of its intensive focus on robotics, as well as its entrepreneurial bent. Additionally, the program takes the unusual approach of bringing students into the professional development process and having them help teachers carry forward the curriculum during the academic year. Teachers also gain a professional learning community and receive classroom visits from NYU Tandon graduate students during the academic year, supporting the program's underlying goal. "The really big idea is that we want to have an influence back at the schools," said Esner.

Another standout aspect is the integration of technology into the practice of science. "Nobody in a life science lab can get by without computer engineering or computer science," said Ben Esner, director of the Center for K12 Stem Education at NYU Tandon. And robotics integrates mechanical engineering, electrical engineering and computer science.

What do participants need to succeed? Teachers need to be committed to the program for the long haul, checking in with NYU Tandon graduate students throughout the year and supporting and empowering student teaching assistants. Teachers must also be involved in bringing students' robotics projects to life in the spring semester.

Upperline Code

Upperline Code provides standalone programs and courses in computer science and software development for middle and high school students, with a focus on practical and soft skills and a classroom culture where mistakes and questions are welcomed.

Who is served: Students ages 13–18. The organization is increasingly working with underserved students in New York City, such as through one-week intensive workshops for 250 10th graders through SEO (Sponsors for Economic Opportunity and another intensive for about 450 women entering their first year of college at CUNY (through WiTNY, Women in Tech and Entrepreneurship in New York)

Number of participants served: 300 in summer 2018; 1,000 in summer 2019

Location: Curriculum / professional development consulting: Success Academy High School of the Liberal Arts, the Dwight School

Frequency/Duration: Summer intensive: 5 sessions, 2 weeks. Professional development: half-day, full-day, and multi-day sessions; twice-yearly exposure workshops for non-CS teachers

Curriculum: Standalone programming and software development courses. The curriculum is very hands-on and skills-based, focusing on full-stack web and mobile applications. "We focus on the languages that developers use in the real world" and "on teaching [students] skills that will last beyond high school and that they can [use to] get an internship right away," said founder Daniel Fenjves.

A three-week program includes databases using MongoDB. One-week programs center around front end work; students learn Javascript, HTML and CSS. A two-week Javascript course dives deeper into front-end development. An iOS development course is available, and Upperline s piloting 2 advanced courses in data science and ReactJS.

Partnerships: DOE/CS4All, Google, JP Morgan, Prep for Prep, SEO, Code Nation, Kipp, Success Academy Network

Cost: Summer 2-week courses: $2,100. In 2018, 37% of Upperline students received scholarships or financial aid for classes; Upperline reserves approximately 20 percent of seats for need-based and diversity-based scholarships.

Sources of funding: Mixed: DOE/CS4All funding curriculum development and teacher training work that Upperline is doing for DOE; other funds from tuition for traditional summer camps; nonprofit and corporate partners that contract with Upperline.

What makes the program stand out? Class sizes are typically 15 students and do not exceed 20, and Upperline has 2 teachers and a teaching assistant in every course. About half of Upperline teachers have never taught computer science before; they're put through an intensive training and then paired with more experienced teachers to lead summer courses. "Our philosophy is that it's much more effective to take an excellent teacher and teach them to code than it is to take a developer and teach them to teach. Those soft skills and classroom management are a lot harder to teach," said Fenjves. "That's a way that we sort of give back, because there's a huge shortage of computer science teachers and the pipeline is really small." Upperline has seen many of those newly trained CS teachers, often math or science or English teachers, "actually go back to their school and start a computer science program."

What do participants need to succeed? "Learning to code is hard. It's scary for many people. And there's a lot of resistance, especially for students who may not see themselves as coders. Generally, women or students of color," said Fenjves. To help students thrive, Upperline goes above and beyond to cultivate a classroom culture "where students feel very comfortable asking for help, making mistakes, reaching out to peers, as well as to teachers." The organization uses improv exercises and "teacher vulnerability," which is aided by having non-CS teachers in classes. Projects also integrate students' interests with the technology they're taught during a course.

What does the organization need? "Finding affordable space in the city to run the classes is hard." Another big challenge is finding qualified teachers who can train new teachers. "It's quite expensive to train a new teacher," said Fenjves.

Brooklyn STEAM Center

Brooklyn STEAM Center is a new approach to career and technical education that embeds Central Brooklyn high school juniors and seniors in a professional environment at Brooklyn Navy Yard.

Who is served: Juniors and seniors attending 8 high schools in Central Brooklyn. Majority are Black or Latinx and qualify for free or reduced price lunch.

Number of participants: Maximum enrollment is 300. The first 2 classes (1 junior class and 1 senior class) were smaller, but STEAM Center expects to enroll full classes of 150 students per year starting fall 2019.

Location: Brooklyn Navy Yard

Frequency/Duration: 5 sessions; half-days throughout junior and senior year

Eligibility Criteria: Students must have time in their junior- and senior-year schedules to attend class at the STEAM Center while still meeting graduation requirements. Each partner school receives an equal seat allocation and determines which students to enroll in the Center.

Curriculum: Students can choose among 5 pathways, including computer science and information technology; construction technology; culinary arts and hospitality management; design and engineering; and film and media. Students can earn industry credentials (listed below). Collaboration, presentation skills and a variety of professional skills, from arriving on time to writing emails, are also emphasized. "Soft skills development is baked into the DNA of the school," said David Ehrenberg, president and CEO of the Brooklyn Navy Yard.

Outcomes: Industry credentials including OSHA 30 (construction technology track), Autodesk and Solidworks (design and engineering track) , NOCTI Prep Cook and NYC Food Handler's License (culinary track), Adobe Pro Premiere (Film track), and Microsoft's Python, Networking, and Security certifications (CS/IT track).

Partnerships: The STEAM Center has an advisory council that is managed and convened by the Brooklyn Navy Yard Development Corporation. This includes over 50 institutions including Yard-based businesses like Russ and Daughters, Crye Precision, New Lab and others, as well as representatives of local education institutions including New York City College of Technology, Brooklyn College, and Pratt.

The STEAM Center has 8 partner high schools: George Westinghouse High School, Benjamin Banneker Academy, Bedford Academy, Science Skills Center High School, Boys and Girls High School, High School for Global Citizenship, Science Technology and Research Early College HS at Erasmus, Medgar Evers College Preparatory High School

Cost: Free

Sources of funding: Mixed

What makes the program stand out? Too often, schools in the city's most vulnerable communities have lacked "high quality CTE experiences that actually lead somewhere," said Dr. Lester W. Young Jr., Regent at Large for the state Board of Regents, who played a critical role in developing the STEAM Center.

The Brooklyn Navy Yard location gives students unique access to more than 400 tech and manufacturing companies. Because students are embedded in a professional environment, they can develop relationships with engineers and architects, for example, who give guest lectures, work on projects with students or lead workshops with real-world applications, according to Ehrenberg.

What do participants need to succeed? Students need for educators to make career and technical education a greater priority, via financial investment in cutting-edge equipment and teachers with industry-relevant knowledge. Otherwise, students won't take CTE seriously, and neither will industry leaders who might employ them.

What does the organization need? Bringing the project to life required significant private sector financial investment, and its success will demand continued willingness on the part of DOE and private industry to collaborate in ways that they haven't before.

ADULT PROGRAM PROFILES

Pursuit

Pursuit is a software developer fellowship program with a deferred tuition model and curriculum structured to include both 1 year of intensive technical training and 3 years of career advancement assistance.

Who is served: Pursuit's cohorts are 50% women, 70% Black or Latinx, 40% immigrant, 60% non-Bachelor's degree holders, and more than 50% public assistance recipients.

Number of participants served annually: 142

Location: Long Island City, Queens

Frequency/Duration: 40 hours per week during the year-long software developer training program, followed by a 36 month career advancement phase. Classes are held both during the day and on nights and weekends.

Eligibility Criteria: Must be 18 years or older and make less than $45,000

Application process: Online application, interview, problem-solving session, and two-day sample coding workshop

Curriculum: Full-stack web and iOS development

Skill level: Advanced

Outcomes: On average, Pursuit Fellows go from making $18,000 before they start Pursuit's training program to $85,000 once they complete the program and secure high-paying jobs in technology. Approximately 25% of participants make more than $100,000.

Partnerships: Grubhub, JP Morgan Chase, Uber, Blue Apron, LinkedIn

Cost: No cost upfront. Training costs are covered by investors in the Pursuit Bond, which fellows repay as a percentage of future income once they get high-paying jobs.

Sources of funding: Pursuit Bond and philanthropic funding

What makes this program stand out? The Pursuit Fellowship offers an intensive 2-phase, 4-year tech training opportunity designed to help build careers that create "permanent change" for "high need, high potential" adults. Fellows take courses in Long Island City where they spend the first 12 months gaining technical mastery before moving into the 36-month long career support phase focused on getting students their first software engineering job. Pursuit emphasizes "industry fluency," exposing students to subjects such as machine learning and artificial intelligence. Experts are often brought in to speak, providing fellows with an opportunity to explore innovative technical fields outside of coding.

What do participants need to succeed? No prior coding experience or knowledge is required, but the program requires a major, year-long time commitment. Admitted students must be available to participate in all scheduled program classes, workshops, and events for the full duration of the program. A demanding time commitment means that some students could benefit from additional cost-of-living supports.

What does the organization need? Additional financing to scale their services to more New York City residents and beyond.

Per Scholas

Per Scholas programs train local talent from overlooked communities for well-paying jobs in IT, cyber security, and systems administration at no cost to participants.

Who is served: Adults from overlooked communities

Number of participants served annually: 800

Location: Brooklyn, the Bronx

Frequency/Duration: Monday to Friday, from 9 a.m to 4 or 5 p.m for 12–19 weeks

Eligibility Criteria: Prospective participants may qualify if they are unemployed, underemployed, or receive public benefits. Participants must be over 18 with a high school diploma or equivalent and authorization to work. They also must have English proficiency and pass a basic academic assessment.

Application process: Online application, in-person interview

Curriculum: Courses in IT support, cyber security, systems administration, application development, and data engineering

Skill level: Mid-level

Outcomes: Provides training and industry-standard certification to prepare participants for the following entry-level positions:
Cloud Support technician: CompTIA Linux+ and AWS Associate Level Certification
IT support technician: CompTIA A+ and Network+ certifications, AWS Solutions Architect certification.
Cybersecurity analyst: Cisco CCNA Cyber Ops Certification
Application developer: Java proficiency

Partnerships: Barclays, The Door (TechBridge), Amazon Web Services, Cognizant

Cost: Free

Sources of funding: City council discretionary funding, corporate partners (e.g. Barclays, Cognizant) and additional foundation support. Youth Career Pathways and high school partnerships are funded through the JP Morgan Chase New Skills for Youth initiative.

What makes the program stand out? Per Scholas provides tuition-free training for adults from often-overlooked communities in IT, cyber security, systems administration, app development, and data engineering. Each pathway incorporates both technical skills training that result in industry-recognized certifications and a career development program that equips students with a job search toolkit, time management skills, and interview preparation. The Per Scholas curriculum is employer-driven, and graduates are matched with employers.

Per Scholas is one of the few training programs that work closely with other nonprofit organizations to build out tech-focused bridge programs. Their first partnership with youth development agency The Door, TechBridge, blends a free, 5-week bridge curriculum with Per Scholas's core programming. Per Scholas has launched a new bridge program in partnership with the Lower East Side Employment Network (LESEN). Per Scholas is also establishing high school partnerships in the Bronx to expose young people to careers in tech through in-school curriculum.

What do participants need to succeed? Participants need to demonstrate a sincere interest in technology and pursuing a tech career. They also must be able to attend classes full-time for the entire duration of the course. Per Scholas supports students throughout the program with case managers and financial coaches. Students are also provided referrals to wraparound services, such as childcare, to help manage their coursework and responsibilities.

What does the organization need? A sustainable source of funding support that allows for flexibility in program design and execution.

Opportunities for a Better Tomorrow: TechSTART

OBT's TechSTART program prepares out-of-school youth with no prior technical experience for careers in cloud support engineering.

Who is served: Out-of-school youth ages 17–24

Number of participants served annually: 66

Location: Industry City, Sunset Park, Brooklyn

Frequency/Duration: Monday to Friday 9 a.m.–5 p.m., 12 weeks

Eligibility Criteria: Must be a 17- to 24-year-old New York City resident with authorization to work in the U.S., high school diploma or equivalent (TASC or GED), and a basic level of computer skills. Applicants must also be able to commit to full-time training, as well as transitioning into full-time employment upon completion of the program. Food stamp recipients are encouraged to apply.

Application process: Online application, in-person interviews, and assessment tasks

Curriculum: Cloud support engineering

Skill level: Intro

Outcomes: Freelance consultant work, advanced coding education, job placement assistance

Partnerships: OBT's TechSTART program is presented in partnership with Generation, a global youth workforce organization. OBT also partners with employers, including tech companies and tech-adjacent companies in retail, hospitality, and healthcare looking for individuals with a more advanced technical skill set. Nonprofit partnerships include joint training programs and referrals for continued career pathways, including Green-Wood Cemetery; Brooklyn Workforce Innovations; Southwest Brooklyn Industrial Development Corporation; SCO - Center for Family Life. OBT also partners with 3 transfer schools through a pilot program with New Visions for Public Schools and JobsFirst NYC, and dozens of schools for referral and outreach.

Cost: Free; pays a daily stipend for transportation and lunch

Sources of funding: About 70 percent from government contracts and 30 percent from foundations, corporations, and individual giving.

What makes this program stand out? TechSTART offers 12-week immersive training for out-of-school youth with limited work experience and a basic level of computer skills. Upon completion of the program, participants receive assistance with job placement including the opportunity to interview for full-time employment with one of OBT's partner employers. Participants acquire foundational skills that can lead to employment or advanced tech training. The curriculum was previously focused on web development but now focuses on cloud support engineering.

Students are also eligible to participate in an internship program to apply and practice their technology skills. Students are paired with Industry City tenants, where OBT is located, and businesses to assist in cloud computing and advanced IT support.

What do participants need to succeed? Participants must be committed to full-time employment and passionate about tech, but unlike Per Scholas and Pursuit, for instance, TechSTART does not require participants to pass a basic academic assessment. It's considered a "bridge program," as it provides tutoring for students whose math and reading skills are not strong enough to keep up with the curriculum.

What does the organization need? Employers interested in hiring our participants for cloud computing or advanced IT roles. Employers can also support the program by providing internships, guest speakers, and coordinating site visits to further expose participants to the tech sector.

NPower

NPower helps military veterans and young adults from underserved communities launch digital careers through their 23-week Tech Fundamentals course, 26-week cybersecurity course, and 12-week cloud computing course.

Who is served: Military veterans and young adults from underserved communities

Number of participants served annually: 256

Location: Fort Greene and Dumbo, Brooklyn; East Harlem, Manhattan

Frequency/Duration: IT (Tech Fundamentals): Monday–Friday, 9 a.m.–1 p.m. or 2–6 p.m., 23 weeks Cybersecurity: Monday–Friday, 9 a.m–4 p.m., 26 weeks Cloud Computing: 12-week hybrid training (14 hours a week online; in-class instruction on Monday, Wednesday, and Friday, 6–8 p.m.)

Eligibility Criteria: To qualify for Tech Fundamentals, applicants must be: 18–25 years old with a high school diploma or equivalent; or an active-duty member of the armed services, military veteran, or spouse over 21. Students must be eligible to work in the United States. Advanced training in cybersecurity and cloud computing is available to qualified NPower alumni. In New York, NPower only runs a young adult cohort for Tech Fundamentals.

Application process: Online application followed by an interview assessing a candidate's commitment to the program and interest in technology

Curriculum: IT, cybersecurity, cloud computing

Skill level: Entry-level, mid-level

Outcomes: Tech Fundamentals: CompTIA IT Fundamentals or A+ certification; Cybersecurity: CompTIA Security+ certification; Cloud Computing: AWS Cloud Practitioner or Solutions Architect certification. Job placement assistance

Partnerships: Local schools and nonprofits for recruitment of students, social support agencies who provide wraparound services for students such as professional attire and financial planning support, employers for internships and job placements. Tech partners include AWS, Symantec, and Cisco Systems.

Cost: Free, paid internship

Sources of funding: Supported by foundations and corporate partners such as Citi, Cisco, and Symantec, charge for-profit companies to bring on their interns

What makes this program stand out? NPower's tech and professional skills program provides free training to military veterans and young adults from underserved communities. In addition to the Tech Fundamentals program, NPower offers cybersecurity and cloud computing courses in their New York City location which culminate in an opportunity to earn certifications in CompTIA Security+, and Cloud Practitioner or AWS Solutions Architect certification, respectively. The advanced training and certifications allow the student to upskill and earn stackable credentials.

What do participants need to succeed? There's no testing required to participate in NPower and the program doesn't screen applicants out based on their reading levels. Applicants are assessed through an interview process that is based on social and emotional capacity. Once enrolled, students can participate in morning or afternoon training, depending on the program.

The half-day programs allow space for students to maintain a part-time job until their paid internships begin 7 weeks before graduation. "We want people who have a desire to change the trajectory of their lives," says Kim Mitchell, Vice President, Program Development and Operations. "To have another chance to pursue an opportunity that doesn't cost them any money but will yield them a middle-skill, solid paying job that will address both their social and economic mobility."

What does the organization need? The organization faces challenges associated with the costs and physical space needed to run the program.

The Knowledge House

The Knowledge House is a nonprofit program dedicated to training and mentoring students from low-income communities to build a successful career in the tech industry.

Who is served: Young adults

Number of participants served annually: 380

Location: Multiple locations in the Bronx, Harlem, and Washington Heights

Frequency/Duration: 3–12 months. Evening and weekend courses available

Eligibility Criteria: Must be a New York City resident 16–30 years old who makes less than $50,000

Application process: Attend info session, online application

Curriculum: Web development, Digital skills training

Skill level: Intro

Outcomes: Bridge employment, internship, part time jobs, freelance opportunities

Partnerships: Tech Talent Pipeline, Bronx CUNY, Workforce1 Career Center, FWD.us, Petrie Foundation, JobsFirstNYC, Kapor Center, New York Community Trust, Siegel Family Foundation, REDF, Arbor Brothers, The Carroll and Milton Petrie Foundation

Cost: Free

Sources of funding: Tech Talent Pipeline; corporate and philanthropic partners

What makes this program stand out? The Knowledge House—one of the few tech training programs located in the Bronx—was founded in 2014 with a mission to create a sustainable tech talent pipeline for high school students and young adults. "A lot of tech training providers either live in the K–12 space or they live in the workforce space. We straddle both fields," says co-founder Jerelyn Rodriguez. "The way we intend to sustain the pipeline is to serve students from high school until they get their first job in tech."

Students participate in a 3- to 12-month program focused on software development skills. Rodriguez says they chose to build a program around software development to fill the gaps in the availability of nonprofit-run hard tech skills programs. The Knowledge House focuses on building stackable credentials that include project management skills and business software (i.e. Slack, Google Drive). It has also started offering a data science course that provides a foundation in Python.

Recently, Rodriguez launched the Bronx Digital Pipeline (BxDP) in partnership with all 3 Bronx-based CUNY schools. BxDP connects out-of-school young adults to training customized to employer needs, leading to entry-level tech jobs. BxDP operates as a referral system for Bronx residents receiving tech training.

What do participants need to succeed? Students must learn Javascript in addition to other programming languages to succeed as a developer in the tech industry today, Rodriguez said.

What does the organization need? Stronger and clearer relationship with tech companies to scale the program. The organization notes that while corporate groups often volunteer or donate to their program, the Knowledge House lacks meaningful engagement that results in companies hiring students from the program.

Coop

Coop connects CUNY graduates to the world of digital media advertising through their free digital marketing and data analytics training courses.

Who is served: CUNY graduates

Number of participants served annually: 173 participants in 2018

Location: Manhattan

Frequency/Duration: Monday–Friday, 9 a.m.–4 p.m., 12 weeks

Eligibility Criteria: Must be a New York City resident between 16–30 years old, hold with a CUNY bachelor's degree who is unemployed or underemployed (making less than $45,000 a year) and a first-generation college grad, financial aid recipient, and/or underrepresented minority.

Application process: Online application

Curriculum: Digital marketing, data analytics

Skill level: Entry-level

Outcomes: 80 percent of alumni begin full-time positions with 1 year. They also receive certifications in Google Ads, Google Analytics, and Facebook Blueprint.

Partnerships: Microsoft and Google

Cost: Free, pays a daily stipend for transportation and lunch

Sources of funding: Foundations (29 percent), corporations (36 percent), and individual giving (35 percent)

What makes this program stand out? COOP was built to help CUNY graduates overcome underemployment and launch careers through digital marketing and data analytics training. The program focuses on tech careers outside of software engineering because "the barrier to entry is lower" and opens students up to the world of digital media advertising.

COOP's digital marketing and data analytics training courses are broken down into "head," "heart," and "hustle." Students go through a total of 200 hours of training: 100 hours focused on hard skills (head), 50 hours focused on developing your personal narrative (heart), and 50 hours dedicated to the job search (hustle).

What do participants need to succeed? Participants need support from peers, which is why the program is built around a network of alumni who not only help foster career connections, but also often return to the program to guide cohorts through the 200-hour training. Dedicated alumni are 1 reason the program is able to offer training at no cost to participants.

What does the organization need? More support recruiting CUNY students

Institute for Career Development's IT Academy

The Institute for Career Development is a nonprofit organization offering a first-of-its-kind IT training program that specifically serves people with disabilities.

Who is served: Adults with disabilities

Number of participants served annually: 16

Location: Manhattan

Frequency/Duration: Monday–Friday, 5 hours each day for 7 months

Eligibility Criteria: Must be an unemployed or underemployed New York State resident with a documented disability, work authorization, a high diploma or equivalency, and the ability to enroll in Adult Career and Continuing Education Services-Vocational Rehabilitation (ACCES-VR). Also must be able to demonstrate a 10th grade level in reading comprehension and math.

Application process: Online application, plus resume and either a cover letter or a 3–5 minute video about yourself. Select applicants then return for pre-assessment tests, including the Test of Adult Basic Education (TABE), Career Ability Placement Survey (CAPS), and a typing test.

Curriculum: IT

Skill level: Entry-level

Outcomes: Cisco certifications in Networking and Cyber Security, paid internship, job placement

Partnerships: Mayor's Office for People with Disabilities' NYC: ATWORK, ACCES-VR, Mayor's Fund to Advance New York City

Cost: Free

Sources of funding: ACCES-VR, Veterans Program funded through VA and private donations

What makes this program stand out? The IT Academy at the Institute for Career Development (ICD) is the first IT training program that specifically serves people with disabilities. "The first cohort took 7 months to get through the curriculum," said Diosdado Gica, Chief Operating Officer of ICD. "But we don't see their disabilities as a challenge, we see their disabilities as a strength."

The IT Academy graduated all of its students enrolled in the first cohort in 2019, and their second cohort is underway. The team at ICD worked with industry partners to design a tech training that aligns with industry needs and ensures program participants are receiving the training necessary to advance into well-paying tech-oriented careers. The IT Academy is built on 4 key components: a fully accessible academy with cutting-edge assistive technology, work readiness, paid internships, and Cisco certification.

While the technical component is essential, ICD emphasizes that work readiness is equally important. Each participant is eligible for a 3-month internship paid for by the employer. Job readiness and acclimation to the work environment are crucial to training, Gica says. Upon completion of the program, ICD follows students for a minimum 90 days through job placement, helping them with transportation to interviews and even assisting with on-boarding.

What do participants need to succeed? Participants must be able to commit to the 6-month training without missing a class, along with the 3-month paid internship (approximately 25 hours per week).

What does the organization need? Additional employer partners willing to mentor students and provide paid internships. Gica also cites a need for professional development training programs to ensure instructors have pedagogical competency and the ability to create lesson plans that teach to different modalities of learning.

MotherCoders

MotherCoders offers tech training to mothers looking to re-enter the workforce, emphasizing the specific challenges faced by women in the tech industry.

Who is served: Mothers

Number of participants served annually: 24 (first cohort graduated April 2019)

Location: Manhattan

Frequency/Duration: Tuesday and Thursday 10 a.m.–1 p.m., Saturday 10 a.m.–4 p.m., 9 weeks

Eligibility Criteria: Must reside in New York City, identify as a woman, be the legal guardian of at least 1 child under 17 years old, hold a bachelor's degree, and have at least 2 years of work experience

Application process: Online application

Curriculum: Coding, user experience design, and analytics

Skill level: Intro

Partnerships: Google

Cost: $4000, $4500 including onsite childcare

Sources of funding: Tuition, individual donations, corporate sponsorships, grants, ticket sales from events, branded merchandise sales

What makes this program stand out? MotherCoders amplifies the skill sets of moms who have degrees by offering training that connects participants to a career path where they can leverage their past work experiences. For the New York City pilot, MotherCoders selected moms from a variety of professional backgrounds including publishing, advertising, project management, and marketing.

What do participants need to succeed? Mothercoders acknowledges and seeks to eliminate the barriers which might prevent moms from participating in intensive tech training by providing on-site childcare.

What does the organization need? More funding to bring down the cost of the program to participants. "Funding this program is not cheap, partly because we have the childcare component," said Lee.

General Assembly

General Assembly attempts to confront the tech and business skills gap through educating individuals and teams in short and long courses focused around on data, engineering, design, business, product management, and more.

Who is served: Adult learners

Number of participants served annually: 12,000

Location: Manhattan

Frequency/Duration: Immersive and accelerated programs meet Monday–Friday from 9 a.m. to 5 p.m. Part-time courses are often in the evenings, or on weekends. General Assembly also offers short-form classes and workshops, ranging from 1 hour to 2 days, as well as free events for career exploration, networking, and community-building. Programs range from 1 hour to 24 weeks.

Application process: Online application. Applicants for full-time Immersives complete admissions assessments to ensure they are prepared for the rigor of the curriculum. Admissions represantatives help prospective participants determine if a course is the best fit.

Curriculum:
Full time: Software engineering, data science, and user experience design. Part time: Python programming, UX Design, Data Analytics, Digital Marketing, Data Science, Product Management, Visual Design, Front-End Development, Java-Script Development, React Development

Skill level: Entry-level, mid-level, advanced

Outcomes: Entry-level jobs, upskilling and re-skilling, career transitions

Partnerships: Employers partner with GA through on-site upskilling and reskilling programs. They have also implemented diversity and impact programs with companies. GA has also run programs in partnership with the New York City Tech Talent Pipeline and nonprofit organizations such as Hack the Hood, IBM P-Tech, LaGuardia Community College, The Last Mile, New York on Tech, the U.S. Department of Labor, Vets in Tech, and more.

Cost: Costs range from $200 for a 1-day bootcamp in digital marketing to $16,000 for a full-time data science immersive course. GA offers a $0 upfront tuition model, loan financing, and installment plans for several courses, in addition to full upfront payment. Scholarships are available.

Sources of funding: Tuition

What makes this program stand out? General Assembly describes itself as "the future of work." It is one of the largest tech bootcamps in New York City, and is known especially for its full-time immersive courses in software engineering. But it also offers a wide variety of courses with varying time commitments, and works extensively with employers on upskilling. GA constantly adapts its course design and overall offering to reflect the most in-demand skill sets. GA provides full time, immersive training in software engineering, data science, and user experience design, while part-time course offerings teach variety of programming languages such as HTML, CSS, JavaScript, Python, and React, as well as product management, visual design, data analytics, digital marketing, and data science.

General Assembly also operates programs in partnership with community-based organizations, nonprofits, and community colleges and offers the See Her Excel Scholarship to women pursuing software engineering.

What do participants need to succeed? Demands vary depending on the program. Some immersives require a full-time, multi-week commitment, while part-time courses are designed for nights and weekends, or 1 week of full-time classes. Given the significant costs and time commitment for some of GA's programs, even with scholarships and merit-based loans, low-income participants can face nontuition barriers.

What does the organization need? Strong relationships with employers to ensure companies are thinking about student skills and competencies in lieu of traditional credentials.

TechBridge—The Door

Offered in partnership with Per Scholas, TechBridge is dedicated to bridging the gap into well-paying jobs in tech for students who qualify for math and English tutoring, providing literacy and math support for young adults who have an interest in tech training.

Who is served: Young adults who are passionate about technology and ready to begin a career in IT but score below the minimum on Per Scholas' entrance exam, the TABE

Number of participants served annually: approximately 80 participants (10–12 per 6–8 week cycle)

Location: The Bronx Youth Center, South Bronx

Eligibility: Must be 18–24 years old, qualify for math and English tutoring, and have an interest in tech training

Frequency/Duration: 5 weeks with The Door, followed by 15 weeks, Monday–Friday from 9 p.m. to 4 p.m. with Per Scholas

Application Process: Written application, TABE testing, and an interview

Curriculum: IT

Skill level: Entry-level

Outcomes: A+ and Network+ certification, entry level roles as computer analyst, tech support, and troubleshooting. The Door tracks outcomes such as quarterly job retention.

Partnerships: Per Scholas, Young Adult Sectoral Employment Project (YASEP) of JobsFirstNYC

Cost: Free, $625 stipend and MetroCard

Sources of funding: DYCD (Department of Youth and Community Development)

What makes this program stand out? TechBridge is a bridge programs dedicated to providing support for young adults who have an interest in tech training but do not have the baseline proficiency in math and literacy they need to qualify for the next step. Offered in partnership with Per Scholas, TechBridge admits students into a 5-week program focused on the foundational math and English skills that are needed to succeed in Per Scholas's intensive IT courses.

TechBridge graduates go on to directly enroll in Per Scholas' IT Support program and earn their A+ and Network+ certifications through the subsequent 15-week program. During their training at Per Scholas students return to The Door once a week to receive academic tutoring. Both organizations are involved in every step of the process, from admission to post-graduation support.

The Door and Per Scholas are currently expanding the TechBridge program to several New York City-based organizations, including Chinatown Manpower Project.

What do participants need to succeed? Students are given a $625 stipend to support their participation in the first 5-week program. The subsequent 15-week program at Per Scholas will be tuition-free, but participants receive no additional financial assistance. Per Scholas helps participants navigate childcare options and other non-tuition issues, but childcare, transportation, and food security can present financial barriers while students are enrolled full-time in the course.

What does the organization need? The organization is in need of more unrestricted funding. TechBridge has open slots in its program, and so could benefit from greater awareness and marketing capacity to reach qualified applicants.

TechConnect—New York Public Library

One of the largest tech training programs operating in New York City, TechConnect serves over 100,000 residents each year offering basic digital literacy courses including classes that teach computer basics and introductory website building at nearly all public library locations.

Who is served: Adults

Number of participants served annually: 118,000

Location: Manhattan, Staten Island, Bronx

Frequency/Duration: Varies

Eligibility Criteria: n/a

Application process: n/a

Curriculum: digital literacy

Skill level: Basic, intro

Outcomes: Training in digital literacy gives participants the baseline skills they need to pursue more advanced coding education, or to qualify for many jobs that require the ability to use a computer and office suite software, or navigate the internet and understand HTML.

Partnerships: Google, Anchor, CodeAcademy, Pursuit

Cost: Free

Sources of funding: TechConnect is funded in part by Bank of America and Wiley. It also receives support from several other corporate and private philanthropies, as well as NYC Connected Communities, a program of the New York City Department of Information Technology and Telecommunications.

What makes this program stand out? The New York Public Library (NYPL)'s TechConnect program is the largest tech training programs operating in New York City. TechConnect serves over 100,000 NYC residents each year through over 80 digital literacy courses which are offered at nearly all branch library locations in the Bronx, Manhattan, and Staten Island. The courses prepare students for the digital world, and include classes in computer basics, Microsoft Office programs, social media, and how to build a website. TechConnect is special for offering tech training in languages other than English, including Mandarin Chinese and Spanish.

Beyond digital literacy classes, TechConnect provides space for students to explore innovative technology and creative editing tools. It also offers one-on-one help via Open Labs. NYPL has plans to add virtual reality courses in addition to a slew of production and digital media classes.

What do participants need to succeed? Participants pay no tuition, and do not need to commit to rigorous attendance. This gives participants the opportunity to take a variety of courses that pique their interest. It also allows working participants to maintain regular work schedules while attending.

What does the organization need? Funding to hire more people to expand offerings and outreach.

Project <code>—New York Public Library

A special initiative with the NYPL TechConnect program, Project <code> offers a free introductory computer programming classes to library patrons in 2 distinct phases.

Who is served: Adult learners

Number of participants served annually: 1000

Location: 58th Street Library and Columbus Library in Manhattan; The Bronx Library Center in the Bronx

Frequency/Duration: 2 two-hour sessions for 12 weeks. Day and evening classes are available but vary by branch location.

Eligibility Criteria: n/a

Application process: n/a

Curriculum: HTML and CSS, Javascript, jQuery, and Bootstrap

Skill level: Intro

Outcomes: Acquire the base programming knowledge needed to build a website, and if interested, enroll in advanced coding bootcamps. Provides participants with upskilling that has enabled some to gain promotions.

Partnerships: Grow with Google, FreeCode Camp

Cost: Free

Sources of funding: Private donors

What makes this program stand out? Project <code> is a free, series-based introduction to computer programming offered through the New York Public Library's TechConnect program. While most TechConnect offerings are individual classes, Project <code> serves as a more in-depth course for those looking to explore new skills that could lead to a career change. The program is an entry point for students before deciding to take a deeper dive into more technical software engineering classes.

Project <code> has 2 phases. Phase I is a 10-week course designed to get students familiar and comfortable with programming languages. The course culminates in a project where students build out the basic structure of a website using HTML and CSS. Phase II builds upon what students learn in Phase I with additional training on how to develop responsive and mobile friendly websites.

After graduating from the program, "We've seen people who have gotten promotions in their jobs," said Brandy McNeill, Associate Director of Tech Education and Training. "After they've got these kinds of web development skills, former students have been asked to take on more tasks and as such has led them to get promoted."

What do participants need to succeed? No prior coding experience required, but participants should plan to fully attend the 12-week program.

What does the organization need? One of the biggest misconceptions is that the organization only operates online and doesn't need people to instruct the classes. TechConnect needs additional funding to hire more people to increase their capacity to offer training.

Flatiron School

A coding bootcamp pioneer, Flatiron School is known for its market-aligned curricula and personal career coaches that prepare participants for careers in software engineering, data science, and UX/UI design.

Who is served: Adults looking to launch a tech career

Number of participants served annually: 274 students in 2017

Location: Manhattan

Frequency/Duration: Monday–Friday, 9 a.m.–6 p.m., 15–24 weeks

Eligibility Criteria: Passion for learning about technology and desire to launch a new career

Application process: Online application, admissions interview, technical review, pre-work

Curriculum: Software Engineering: HTML5 & CSS, JavaScript, React, Ruby, and Rails (15 weeks). Data Science: Python, Object Oriented Programming, JSON, Web Scraping (15 weeks). UX/UI design: User-Centered Design, Design Thinking, Design Principles (24 weeks)

Skill level: Mid-level, advanced

Outcomes: Of 2017 participants, 95% (260) graduated. Of the participants who completed a job-search cycle upon graduating, 31% accepted a job within 30 days, 55% within 60, 91% within 180, and 97% within a year. Average starting salary for a full-time salaried role was $73,806.

Partnerships: WeWork, Access Labs, Designation

Cost: $17,000. Flatiron offers financing options and deferred tuition through income sharing agreements.

Sources of funding: Tuition

What makes this program stand out? Flatiron School is a 15-week software engineering bootcamp that offers a combination of full-time courses in-person and online. It is specifically designed for adult learners looking to transition to a career in tech. Last year, the school launched Access Labs Initiatives for New York City residents making less than $35,000 to increase access to tech training. In New York City, Flatiron offers software engineering, data science, and UX/UI design training. Founded in 2012, Flatiron is one of the earliest accelerated programming courses and pioneered the tech bootcamp model. Flatiron was acquired by WeWork in 2017, and now operates out of WeWork locations throughout the world.

On the software engineering track, students are trained in both front-end and back-end web development to become full-stack engineers. Students also learn about product management, computer science fundamentals, and receive technical interview training. Data science course teaches both programming languages specific to data science and "statistical understanding." Students also learn how to use algorithms to draw insights from data, big data, and machine learning APIs.

The UX/UI design track is a hybrid course that allows students to study independently through online coursework for the first half of the class. The curriculum—created by Designation, a design education program—focuses on the fundamentals of user-centered design, design thinking, design principles, prototyping, and frameworks among other presentation and portfolio skills.

What do participants need to succeed? The Flatiron program is designed for individuals seeking a full career transformation, and so it requires a major time commitment and investment. Flatiron has introduced an income share agreement to break down the significant upfront cost, and it also provides a tuition-back guarantee for those unable to land a job in 6 months.

What does the organization need? The organization has a big focus on hiring teachers and finding people who are both educators and have the technical prowess to facilitate training.

Access Labs Initiative, Flatiron School

The Access Labs Initiative is designed to bring the coding bootcamp experience to New Yorkers earning less than $35,000 a year.

Who is served: Low-income adults

Number of participants served annually: Approximately 200 enrolled students in 2018

Location: DUMBO, Brooklyn

Frequency/Duration: Monday–Friday, 9 a.m.–6 p.m., 15 weeks

Eligibility Criteria: Applicants must be 21 or older at the start of the program, earn less than $35,000 per year, hold a high school degree or equivalent, and be legally authorized to work.

Application process: Applicants submit a written personal statement and complete both an admission interview and technical review

Curriculum: Curriculum follows Flatiron School's software engineering immersive: HTML5 and CSS, JavaScript, React, Ruby, and Rails.

Skill level: Advanced

Outcomes: Careers in software engineering

Partnerships: WeWork, Flatiron School, 2U

Cost: $0 upfront. Upon securing a job in tech, graduates pay a percentage of income in monthly installments until tuition is covered.

Sources of funding: Flatiron School, Tuition

What makes this program stand out? Access Labs is a Flatiron School initiative geared towards removing barriers to accessing intensive, bootcamp-style tech training for low income New Yorkers.

The program launched in April 2018 and operates out of the WeWork Dumbo space. Access Labs is committed to creating an equitable tech ecosystem and equipping students with the soft skills they need to succeed in their tech careers.

To prepare admitted students for the rigor of the full-time, on-campus immersive, all participants complete a 100-hour introduction to programming course before stepping on campus.

The technical curriculum offered through Access Labs is nearly identical to the coursework in Flatiron School's flagship software engineering immersive: a full-time, 15-week program broken into 5 3-week modules starting with the fundamentals like HTML5 and CSS to get students comfortable with object-oriented programming. The program culminates in a showcase of independent portfolio projects.

What do participants need to succeed? The Access Labs program is designed for individuals seeking a full career transformation, and so it requires a major time commitment and motivation. Even with deferred tuition, the time commitment of the program may present barriers to some students who need additional support in covering non-tuition costs such as childcare and food while they are enrolled full-time.

What does the organization need? Additional support for students to fully immerse themselves in the tech training. There is a need to ensure that students understand financing options and that they have access to a variety of financing options.

Fullstack Academy

Fullstack Academy offers a JavaScript-oriented curriculum structured as part of full-time and part-time immersive software engineering bootcamps and cyber security bootcamps.

Who is served: Adults

Number of participants served annually: 900-1000

Location: Financial District, Manhattan

Frequency/Duration: 4-week remote Foundations course (25 hours per week); 13-week full-time Core Curriculum (Monday–Friday, 9 a.m.–6:30 p.m. and later)

Eligibility Criteria: Some programming experience is required. Fullstack offers a Bootcamp Prep course that covers the intermediate coding skills required to pass their assessment

Application process: Online application, coding assessment, technical interview via Skype

Curriculum: JavaScript-centric full-stack web and mobile app development; cyber security

Skill level: Mid-level, advanced

Outcomes: Most participants (66.7% in the most recent reporting period) are hired for full time software engineering jobs within 180 days of graduating.

Partnerships: Tech Talent Pipeline, Grace Hopper, Bloomberg, American Express, Spotify, Google, and Amazon.

Cost: $17,910 up-front or through loan-based financing. A $1,000 need-based scholarship is available for qualifying women and veterans. In partnership with Tech Talent Pipeline, Fullstack offers a Web Development Fellowship covering the full cost of tuition.

Sources of funding: Tuition

What makes this program stand out? Fullstack Academy is designed for students with some experience in programming seeking to bolster their skills in the latest web development technologies, increasing their access to current employment opportunities. The program curriculum is JavaScript-oriented and trains students in both front and back-end technologies. Fullstack works to maintain employer relevancy and consistently adapts their curriculum based on market needs.

The 17-week course begins with 4 weeks of remote work where students independently study programming fundamentals. The remaining 13 weeks are full time with a focus on full stack Javascript, which trains students in frontend and backend development and databases. Throughout the course, students also complete several projects to apply their skills. David Yang, co-founder of Fullstack Academy, notes computational thinking is crucial to programming and learning algorithms are core skills that equip students with the problem-solving employers are seeking.

Fullstack is also home to immersive coding programs serving underrepresented communities including the Grace Hopper Program and the NYC Tech Talent Pipeline Web Development Fellowship.

"Working with Tech Talent Pipeline, our partners have been able to help us figure out how to create maximize social economic impact," said Yang.

What do participants need to succeed?
Fullstack has a competitive admissions process and is not designed for individuals with no prior experience in coding. This means that even those with some experience will need to prepare for the admissions process as well as the full program. During the program, participants must be able to commit to 10-plus hour days.

What does the organization need? More student awareness to get prospective students to think outside of the box in terms of an education path. The organization also needs funding to continue running a large program in New York City with high quality instructors.

Grace Hopper at Fullstack Academy

Grace Hopper Academy offers a 17-week, immersive software engineering course to women and non-binary individuals with no upfront tuition costs.

Who is served: Women and non-binary individuals

Number of participants served annually: 137

Location: Financial District, Manhattan

Frequency/Duration: 4-week remote Foundations course (25 hours per week); 13-week full-time Core Curriculum (Monday–Friday, 9 a.m.–6:30 p.m. and later)

Eligibility Criteria: Applicants must be 18 years or older (no age limit) and successfully complete their admissions assessments. No previous education, employment, or financial requirements, except in the case of those who want to access the deferred tuition (need to provide documentation stating authorization to work in the US).

Application process: Timed hacker rank assessment and live/remote pair programming challenge with technical staff

Curriculum: full-stack software development: Javascript, HTML, CSS, jQuery, and more.

Skill level: Advanced

Partnerships: Black Girls Code, Lesbians Who Tech

Outcomes: For Grace Hopper's most recent reporting period (Jan-July 2018) 70 percent of graduates were employed full-time with 180 days of graduation, with a median annual base salary of $91,100.

Cost: Deferred tuition model. $19,910 tuition is paid in 9 monthly installments after graduates are hired full-time and begin work as a developer. A $3000 enrollment deposit is applied toward the total tuition once hired. If graduates are not hired within 1 year, the deposit is refunded. Scholarships through Lesbians Who Tech are available for those who qualify

Sources of funding: Deferred tuition model (train now, pay later) means the program is fully funded by their graduates. As a program of Fullstack Academy, Grace Hopper receives an initial investment from Fullstack, but the program is sustained by deferred tuition payments from fully-employed graduates.

What makes this program stand out? Grace Hopper Academy—named after the pioneering computer scientist—is a bootcamp founded to attract more women to tech careers. The program is provided through their partner coding school Fullstack Academy, and is a software engineering immersive designed exclusively for women with a deferred-tuition model. That means participants are only required to pay tuition once they are employed as software engineers.

"We noticed that our flagship programs at Fullstack Academy, despite different scholarship models and different incentives, weren't really seeing results in increasing the gender diversity in our cohort," said Michele Cantos, director of Grace Hopper Academy, on how the program was founded.

Students are equipped with computer science fundamentals in the first weeks of the program gaining a theoretical understanding of web development. Grace Hopper's philosophy around education is "learn through teaching." This has informed the focus on paired programming and group projects students work on that mimic a real-world software development environments.

Grace Hopper participants complete the program with 3 projects in tow, 1 solo project and 2 team projects. The capstone project is the largest undertaking, which students present to the Grace Hopper community at the culminating "Demo Day." All projects are added to the students' portfolio and used to demonstrate their work throughout the interview process.

What do participants need to succeed? Grace Hopper offers prep courses for prospective students looking to gain admittance into the bootcamp. The immersive course is not designed for beginners, and expects students need to demonstrate coding proficiency before admission.

What does the organization need? More space and more female engineering instructors.

CUNY Tech Prep

Geared CUNY Tech Prep is a year-long, full-stack Javascript program geared towards CUNY computer science and computer information systems majors.

Who is served: Computer science students enrolled in 1 of the 11 senior colleges across New York City

Number of participants served annually: 125 students in 2019-2020

Location: CUNY Institute for Software Design and Development, CUNY Grad Center, Manhattan

Frequency/Duration: 1 year

Eligibility Criteria: The 2020-2021 program is open to students who will be attending a CUNY senior college in Fall 2020, have completed a course in Data Structures, are a Computer Science or related major, are 18 years or older, do not make more than $50,000 per year and are legally able to work in the U.S.

Application process: Online application, HackerRank Challenge, in-person whiteboarding, and behavioral interview. Admissions are competitive: for 2019-2020, only 125 students out of 400 applicants were accepted.

Curriculum: Full stack web development: HTML, CSS, Javascript, Bootstrap, React.js (front end) and Node.js, Express.js, Postgresql, and MongoDB (back end).

Skill level: Advanced

Outcomes: 75 perfect landed a job or internship within 5 months of completing CTP

Partnerships: CodePath, 36 industry partners

Cost: Free

Sources of funding: New York City Tech Talent Pipeline

What makes this program stand out? CUNY Tech Prep caters to computer science and computer information systems students enrolled in 1 of the 11 senior colleges across New York City.

Students participate in weekly technical classes and are challenged to develop their own individual projects to apply their skills. In their capstone project, students work in teams to build a full-stack web application. Each team is assigned a mentor that provides supervision, introduces concepts and best practices, and performs code reviews. The project culminates in a Demo Night/ Graduation Celebration hosted by local NYC tech companies like Squarespace, where students demo their projects for NYC tech employers.

Technical interview preparation is a core focus during the second half of the year long program. CUNY Tech Prep has identified the technical interview as one of the major components that turn job applicants into employees. The program provides both mock interview prep and equips students with the frameworks necessary for students to successfully complete whiteboarding during the job application phase.

What do participants need to succeed? Beyond technical skills, students need mentoring and support to prepare for employment in the tech industry. Each CTP participant is assigned a career coach who works closely with them throughout the year to help them understand the landscape of the tech industry. Students are advised on how to create a technical resume and proper cover letter, undergo mock interviews, learn how to network at industry events, and more—cultivating the soft skills that, along with full-stack coding expertise, will enable them to break into New York's tech sector

What does the organization need? The capacity and ability to make changes based on student needs and industry partners priorities.

CUNY Tech Works

CUNY Tech Works is a community college-based training program that offers bootcamps and part-time programming courses at no cost in order to help underemployed and unemployed individuals successfully enter New York's tech sector

Who is served: Underrepresented groups in tech

Number of participants served annually: 350

Location: Manhattan

Frequency/Duration: Summer Bootcamp Program: 10 weeks, Monday–Friday, 10 a.m.–6 p.m.
Part-Time For-Credit Program: Weeknights (typically Monday–Thursday for 2–3 hours)

Eligibility Criteria: Must be 18 years or older, hold a high school diploma or equivalent (GED/TASC), be eligible to work in the United States, and unemployed or underemployed.

Application process: Attend an information session, fill out online application, TABE (Test of Adult Basic Education), interview

Curriculum: IT (CompTIA A+ and Cisco Certified Network Associate (CCNA) certification), UX (human-centered design, HTML, CSS, and Javascript, project management), Software development (C++, mobile and web applications, etc.)

Partnerships: Robert Half, Borough of Manhattan Community College (BMCC), Kingsborough Community College (KCC), and Queensborough Community College (QCC) – CUNY CEWP

Skill level: Intro, entry-level

Outcomes: Acquire certifications that qualify participants for entry-level positions as an IT professional. Software development students graduate with 13 college credits which can be used towards an AAS degree in Internet and Information Technology. Participants also create a GitHub portfolio highlighting their work.

Cost: Free. The program covers tuition and textbook costs, though textbooks must be returned.

Sources of funding: Funded by an America's Promise grant from the U.S. Department of Labor's Employment and Training Administration

What makes this program stand out? CUNY Tech Works is an employment and training program that offers tech training, internships, career counseling, and job placement. Tech Works operates in partnership with 3 community colleges, each with its own course offering: Borough of Manhattan Community College (BMCC) offers IT management; Kingsborough Community College (KCC) offers user experience (UX) design; and Queensborough Community College (QCC) offers software development.

CUNY Tech Works has 2 pathways: a full-time, intensive summer bootcamp and a part-time for credit program. The bootcamp offers the quickest path to employment, while the year-long part-time program yields college credits which can be applied to an associate's degree in internet and information technology (AAS in IIT). Both programs are geared towards getting participants into tech careers, and offer help with online portfolios, job search and placement, and access to paid internship opportunities.

Though community college students are heavily recruited for the program, CUNY Tech Works is ultimately a workforce development program open to all applicants who meet the basic qualifications. The program, operated through CUNY's Office of Continuing Education and Workforce Programs (CEWP), is designed to address the gaps in access to tech education for underrepresented and low-income communities.

What do participants need to succeed? Students need support in order to break into the tech sector. They have access to industry experts who act as career coaches and help students develop professional skills that pertain to the tech space like project management and understanding the life cycle of software. Schools also host hackathons, industry talks, and other events to promote access.

What does the organization need? Funding and bridge programming for adult learners.

Goodwill

Launched in partnership with Google, Goodwill's tiered approach to tech skills is designed to support a wide range of learners to improve their digital literacy and get on the path to in-demand tech careers.

Who is served: Adults

Number of participants served annually: 10,000 (digital literacy), 70 (tech skills)

Location: New York City

Frequency/Duration: 1 day–10 months depending on the program

Eligibility Criteria: varies

Application process: varies depending on program

Curriculum: digital literacy, IT, software engineering

Skill level: Basic, intro

Partnerships: Grow with Google, NPower, Pursuit

Cost: Free

Sources of funding: Google.org

What makes this program stand out? The Goodwill Digital Career Accelerator® launched in 2017 with a 3-year, $10.3 million Google.org grant. A national program, it provides 5 levels of digital skills training including: Digital Skills Awareness, Basic Digital Skills Training, Productivity Software Skills, Entry-Level Digital Skills, Mid-level and Occupation-Specific Digital Skills.

The first 3 levels offer entry level computer skills training to those looking to gain general familiarity with the digital landscape. These internal Goodwill programs teach participants skills such as how to access email, use keyboards, and how to work with Microsoft Suite products. Levels 4 and 5 are advanced web development training offered through partner tech training organizations including NPower and Pursuit.

What do participants need to succeed? Recognizing that non-tuition financial issues can prevent students from participating in or completing advanced, intensive tech training courses, Goodwill steps in to assist students participating in advanced training at partner organizations. Goodwill connects participants with resources for transportation, including gas cards or Metrocards. Goodwill also assists participants with job placements and retention services.

What does the organization need? Additional funding to expand reach.

Media Labs—NYC Parks

The New York City Department of Parks and Recreation operates 32 media labs across the 5 boroughs, with 22 offering a range of digital skills programs including multimedia production and computer literacy.

Who is served: New York City residents

Number of participants served annually: 10,337 (4230 adults)

Location: New York City

Frequency/Duration: Varies, 6-8 weeks, once or twice per week

Curriculum: Microsoft Office, Adobe Creative Suite, multimedia production, computer literacy, web design

Skill level: Basic

Outcomes: Participants can receive certifications including Microsoft Office Specialist, Adobe Certified Associate

Partnerships: Educational Video Center, Pathways to Graduation, the Girl Scouts, MakerSpace NYC, NYC Salt Photography Program

Cost: Free (Membership required, annual fee of $25-$150)

Sources of funding: New York City Department of Parks and Recreation

What makes this program stand out? Media Labs makes digital literacy, office suite, and tech design training available to New Yorkers through Parks Department recreation centers. With 5 locations in the Bronx, 6 in Brooklyn, 12 in Manhattan, 6 in Queens, and 1 in Staten Island, Media Labs help make basic tech training accessible throughout the 5 boroughs. Most Media Labs have offer both open hours and programmed media education courses for a range of age and skill levels, including programs for job seekers. In total, 22 locations have Tech Opps programs— instructor-led courses which offer industry-standard certifications in Microsoft and Adobe software.

The Labs also offer workforce development courses that focus on online job searching and resume writing. "We empower our communities and the voices in those communities to become producers of content and to be more of the storytellers," says Keenan Houser, program developer for Media Education of classes offered through the media labs.

What do participants need to succeed? To participate in a Media Lab class, a recreation center membership is required. For some programs, participants must commit to attend all classes.

What does the organization need? More STEM and coding programs at Media Lab locations around the city equipped with interdisciplinary instructors who are trained technologists.

ACE

The Association of Community Employment Programs for the Homeless (ACE) provides vocational rehabilitation and workforce development training for recovering homeless individuals with courses ranging from basic literacy and numeracy to computer proficiency.

Who is served: Recovering homeless individuals

Number of participants served annually: 147

Location: Based in Long Island City, Queens, but provides assistance throughout New York City

Frequency/Duration: Varies by participant, but can be 1 year or longer

Eligibility Criteria: Eligibility is somewhat flexible, but you must be willing and able to pursue full-time employment. Typical requirements include having housing through a shelter, treatment program, or other means, and thirty days of sobriety.

Application process: Rolling admission process with an intake session every Tuesday and Wednesday at 10 am.

Curriculum: digital and computer literacy skills

Skill level: Basic

Outcomes: full-time permanent employment

Partnerships: *Program Partners:* Bottomless Closet, Career Gear, Community Service Society (CSS), Dress for Success, Educational Alliance, Good Old Lower East Side (GOLES), John Jay College, Kennedy Counseling and Wellness, Kibel Companies, Nazareth House, New York Public Library, Project Renewal, St. John's Bread and Life, That Suits You, The Financial Clinic, Valley National Bank

Education and Training Partners: Blackhawk Security School, Ferrari Driving School, New York City Department of Health and Mental Hygiene, New York Safety and Training, WrightCo Environmental Solutions

Cost: Free

Sources of funding: ACE is funded through private and foundational giving. They have also developed program revenue through sanitation contracts, which hire program participants. All participants earn at least $15 minimum wage, and full-time employees are eligible for health care and 401K benefits packages.

What makes this program stand out? The Association of Community Employment Programs for the Homeless (ACE) serves homeless men and women across New York City with several initiatives including an adult education program called Project Comeback. ACE occupies a "bridge space" in that its education programs providing a blend of vocational rehabilitation and workforce development.

Project Comeback offers individuals daily classes and workshops to provide the skills and support they need to achieve economic independence. Courses range from basic literacy and numeracy to computer proficiency. "We're serving a population that's pretty unique," explains Travis Tinney, Director of Development for ACE. Few clients come to ACE with a background or experience in technology.

What do participants need to succeed? Participants need to be committed to seeking full-time employment and maintaining sobriety. Recognizing the difficulties faced by homeless individuals, ACE provides intensive case management for people searching for housing and undergoing substance abuse treatment. It also structures programs around shorter timelines so that participants can more quickly move out of shelters and start working. It also serves clients for as long as necessary and maintain relationships after they have found full-time employment. While all program participants go through basic computer training, Tinney notes that lack of computer proficiency is not what's preventing the population ACE serves from accessing economic opportunity.

What does the organization need? More funding to put more homeless individuals through the program.

CAMBA/Cooper Union Retraining Program

The CAMBA program helps immigrant engineers and IT professionals translate their prior education and experience into jobs in the tech and engineering sectors.

Who is served: Unemployed or underemployed immigrant engineers and IT professionals

Number of participants served annually: Over 225 students

Location: Manhattan

Frequency/Duration: Most courses meet once a week for 8–12 weeks and take place at night or on the weekends. Total retraining program duration varies by student.

Eligibility Criteria: The applicant must be an immigrant with work authorization; have a Bachelor's degree or higher in the field of engineering or IT from their country of origin; be unemployed, underemployed, or working in a field not related to their education; have intermediate-level English proficiency; and demonstrate a financial need.

Application process: Applicants submit a detailed application form and resume to CAMBA via email. They are then contacted for phone screening, and if eligible, invited for in-person registration at CAMBA's Brooklyn office.

Curriculum: Qualified participants can choose from approximately 20 semester-long courses in information technology and chemical, mechanical, electrical and civil engineering taught by Cooper Union faculty and field experts.

Skill level: Advanced

Outcomes: 70 percent of participants connect to job as a result of the program and average a $28,000 salary increase.

Partnerships: The program is itself a partnership between CAMBA and Cooper Union's Albert Nerken School of Engineering. It partners with scores of employers who have expressed interest in hiring program graduates.

Cost: Free

Sources of funding: The Robin Hood Foundation and Con Edison

What makes this program stand out? The Cooper Union's Retraining Program for Immigrant Engineers operates with workforce partner CAMBA—a nonprofit incubator—to train roughly 250 highly skilled IT professionals and engineers from 60 different countries each year. CAMBA—who is responsible for recruiting students—reports that an average of 30 percent of students admitted are refugees or political asylees.

The program is designed for immigrant professionals who have a bachelor's degree from an accredited college or institution in their home countries. Many students also have substantive work histories in engineering and IT, but require retraining in order to bring their engineering, computer programming, and business management skills up to date and in line with the demands of the American job market.

The goal of the Retraining Program is to match unemployed or underemployed participants with the American labor market and to find them a gateway job and path back to their profession.

What do participants need to succeed? This program is catered towards a specific population: highly skilled immigrant engineers and IT professionals who need retraining to return to their profession within the context of the US labor market. Accordingly, they need to focus their retraining coursework on the areas in which they gained education and experience in their countries of origin. Cooper Union and CAMBA recognize and work to tackle the multiple barriers may be preventing participants from returning to their career profession. Cooper Union provides engineering and IT coursework, while CAMBA provides the soft skills development like interview preparation, networking, and job retention. "When you're working with skilled immigrant professionals, it takes time and investment both by the individual and by program in order to address all the barriers there are to connect to one's profession," said Eileen Reilly, Vice President for Economic Development at CAMBA.

What does the organization need? More support around recruiting immigrant engineers.

LaGuardia TechHIRE—Open Code

LaGuardia Community College's TechHIRE—Open Code program trains young adult job-seekers in web development, software development, and network administration.

Who is served: Young adults ages 17–29

Number of participants served annually: 120

Location: Long Island City, Queens

Frequency/Duration: 5 weeks before moving to training partners

Eligibility Criteria: Must be unemployed or underemployed, not currently enrolled in college, hold a high school diploma or equivalent, and have basic computer skills

Application process: Online application, assessment during the application process to gauge interest, and interview

Curriculum: programming fundamentals, product development, and web development (Java, CSS, HTML), network administration (CompTIA A+ and N+ certification)

Skill level: Entry-level

Outcomes: Prepares participants for advanced technical training with partner organizations

Partnerships: General Assembly, Udacity, Software Guild, and Uncubed.

Cost: Free

Sources of funding: Funded through a grant from the U.S. Department of Labor's Employment and Training Administration

What makes this program stand out? LaGuardia TechHIRE—Open Code operates what can be considered a "bridge program" for non-degree seeking students through the Division of Adult and Continuing Education (ACE) at the community college. Michele Valdez, director of the program, reports that Open Code has a relatively high acceptance rate. Once enrolled, students go through a 2-week "vestibule" course at LaGuardia where they learn basic programming languages and concepts to get comfortable with learning code. They also participate in career exploration exercises with Uncubed, a digital jobs search website, giving students insight into working at startups in the tech world. Upon completion of the introductory course, case managers assess a student's ability to move forward in the programs looking at everything from attendance to how well they work in teams.

The curriculum is designed to train students in computer science fundamentals and gain familiarity with software tools used to create websites. Once students complete the training with partner organizations, they return to LaGuardia and begin technical interview preparation.

What do participants need to succeed? TechHire—Open Code is a bride program that seeks to not only prepare participants for intensive tech training with partner organizations, but also help them overcome barriers which may be obstacles to success. Participants have access to all services available to LaGuardia Community College students including the food pantry and wellness center, even throughout the duration of their training at partner providers to ensure they have their needs met.

What does the organization need? Close partnerships with community-based organizations and workforce development organizations that raise awareness about these training opportunities.

Year Up

Year Up is a one-year, intensive training program that aims to close the opportunity divide by providing young adults with 6 months of skills development and coursework followed by a 6-month corporate internship

Who is served: Underserved young adults ages 18–24

Number of participants served annually: 450+

Location: New York City

Frequency/Duration: Monday–Friday, 6 months in training followed by a 6-month internship

Eligibility Criteria: Must be 18–24 years old and hold a high school diploma or GED recipient

Application process: Candidates apply online, attend info sessions, and then go through a series of interviews

Curriculum: Career pathways and specialized training areas include Software Development (Application Development & Support), Information Technology (Cyber Security and Helpdesk/Desktop Support), Financial Operations (Accounting & Corporate Finance and Investment Operations), and Business Operations

Skill level: Entry-level

Outcomes: 90% of graduates are employed and/or enrolled in postsecondary education within four months of program completion, with employed graduates earning an average starting salary of $40,000 per year. Participants also earn up to 30 college credits throughout the program.

Partnerships: American Express, Bank of America, BNY Mellon, Fidelity, JP Morgan Chase & Co, Morgan Stanley and New York Life

Cost: Free, includes stipend

Sources of funding: Over 60 percent of funding is generated through internship fees paid by participating companies

What makes this program stand out? Year Up begins with students in training for 6 months followed by a 6-month internship with an employer partner. The program sets high expectations for work and professionalism, and includes a mix of technical classes like hardware repair and networking, and professional and communication classes such as business writing and negotiating. The soft skills training helps students position themselves in the workforce and navigate a tech focused career pathway. Throughout the program participants are partnered with a staff member who acts as an advisor/coach to provide ongoing support and career guidance.

"We're always thinking about how to close the opportunity divide," said executive director John Galante, who reports 90 percent of graduates are employed and/or enrolled in postsecondary education within four months of program completion.

What do participants need to succeed? Year Up acknowledges the critical value of wraparound services for ensuring student success. Participants are supported by staff advisors, professional mentors, dedicated social services staff, and other community-based partners.

What does the organization need? Continued corporate support as well as community and college partners. The organization is also always in search of professionals to serve as mentors or partake in one-time volunteer opportunities that support its young adults.

App Academy

App Academy is an intensive, 12-week, Ruby-focused web development course with a full stack curriculum and deferred tuition model.

Who is served: Adults

Number of participants served annually: Approximately 240 (60 students per cohort)

Location: Manhattan

Frequency/Duration: 12 weeks, Monday–Friday, 9 a.m.–6 p.m.

Eligibility Criteria: Anyone with a high school diploma or other equivalency who is comfortable using a computer. However, admissions are highly competitive, and prior programming experience will help.

Application process: A logical reasoning and reading exercise, a coding challenge, a technical interview, and a non-technical interview. Acceptance rate is less than 5 percent.

Curriculum: Software engineering: HTML, CSS, Java, Ruby on Rails, JavaScript, React, Redux, SQL, Advanced Algorithms, and Data Structures

Skill level: Advanced

Outcomes: Full-time employment as a software engineer. 2018 graduates earned a median salary of $90,000.

Partnerships: Google and Wayfair to Fortune 500 companies, and startups looking to hire their first software engineers

Cost: Upfront: $17,000
Placement-based plan: $3,000 deposit, with $25,000 due after securing employment with a salary of at least $50,000
Hybrid: Pay $9,000 up front; owe $14,000 after securing employment.

Sources of funding: Tuition

What makes this program stand out? App Academy is a 12-week full-time software engineering course. The program was one of the first coding bootcamps to be founded on a deferred tuition model in an effort to make tech training more accessible by defraying upfront costs. In some payment plans, all or part of tuition is only owed once a student is hired and making at least $50,000.

"It reflects our confidence in our program and the investment we all put into career coaches and career development," said Sarah Sedeak, Partnerships Associate at App Academy.

During the final weeks of the course, participants receive instruction in resume writing, interview skills, negotiations, and technical interview prep. Additionally, the program equips students with industry knowledge giving them insights into how a tech companies operate. An optional 13th week is provided for students to brush up and refine technical skills and participate in interview practice.

What do participants need to succeed? Participants need to be ready for a very substantial time commitment that exceeds the 45 hours per week of formal course time. App Academy reports that "students should expect to put in about 90–100 hours every week." This means that the program may not be well suited for individuals with considerable responsibilities outside of work. The program is immersive and intense, and App Academy has an attrition rate of about 15 percent.

What does the organization need? Find the right students to ensure the program admits participants who can become software engineers in a short amount of time.

Byte Academy

Byte Academy is an industry-focused coding school with courses including Python Fullstack and Data Science

Who is served: Adults

Number of participants served annually: 100

Location: Manhattan

Frequency/Duration: Immersives: 14 weeks, Monday–Friday, 10 a.m.–5 p.m.
Part-Time: 4–24 weeks, 2 days per week, 6 p.m.–9 p.m.

Eligibility Criteria: No technical experience necessary

Application process: Completion of a coding challenge and a technical interview is required to assess how students work through problems

Curriculum: Web development in Python, Javascript, React, HTML, and CSS; Data science in Pynthon involving Pandas, statistics, visualization, prediction and machine learning, natural language processing, data wrangling, statistical modeling, regression, Hadoop, SQL, NoSQL and more.

Partnerships: Employers help Byte Academy tweak their curriculum to meet hiring needs. Byte Academy has teamed up with schools and universities for events, workshops, and the launch of new initiatives.

Skill level: Advanced

Outcomes: Increased salary, job placement

Cost: $14,950

Sources of funding: Primarily privately funded

What makes this program stand out? Byte Academy was one of the first programs to offer a Python-focused coding bootcamp curriculum and intimate classes with roughly 5 students per instructor. Byte Academy's small class sizes help create a collaborative, seminar style environment. It also pioneered specializations in FinTech and Blockchain.

Byte Academy offers 3 courses out of its New York City Location: Python Foundation, Python Fullstack, and Data Science, available as immersive, full-time courses, or bi-weekly part-time courses in the evening. All courses are centered on the Python programming language, but they vary in terms of their intensity and focus. Python Fullstack teaches HTML, CSS, and Javascript alongside Python backend development and data toolkits, while Data Science focuses on data analysis, machine learning, modeling, and other topics, with an aim to help students develop industry-specific applications.

Students also receive dedicated career coaching including resume and interview prep to help with job placement.

What do participants need to succeed? Students don't need to have technical experience before submitting an application. Once admitted, students complete 20 hours of pre work before the first day of class. Byte also has a Python foundations prep course; which students can complete and gain automatic admission into the full-time program. Byte Academy immersive courses demand a major time commitment: during the immersive program, students report spending an additional 20–40 hours per week outside the classroom in addition to the 40 in-class hours.

What does the organization need? Strategize around delivering high quality education at scale. The organization has a need to ensure that the curriculum is always up to date and aligned with industry standards.

Metis

Metis is a rigorous data science training program with a competitive application and selection process.

Who is served: Adults with programming and statistics experience

Number of participants served annually: 22–30

Location: Manhattan

Frequency/Duration: Monday–Friday, 9 a.m.–5 p.m., 12 weeks

Eligibility Criteria: Must have experience with Python programming and statistics

Application process: Online application with work and educational background, technical self-assessment, and goals, followed by a 5-hour time-limited technical challenge with a mix of questions in math, statistics, Python, as well as a data analysis and data science project. Select applicants move on to a 30 minute alumni interview, followed by an application review to evaluate overall preparedness.

Curriculum: Data science: Python, machine learning, web scraping, collaborative and cloud-based coding, visualization, distributed algorithms and systems architecture.

Skill level: Advanced

Outcomes: Full-time data science roles

Partnerships: Metis works with numerous companies and institutions that contract the organization to provide corporate data science training. They also collaborate with many different organizations and meetups to jointly promote data science opportunities

Cost: $17,000

Sources of funding: Tuition and corporate contracts

What makes this program stand out? Metis was the first data science bootcamp in New York City, and claims to be the only accredited one. It is a product of Kaplan educational services.

Metis is a rigorous program with a competitive application and selection process. Applicants must have experience with programming and statistics prior to enrolling into the program. Students are typically professionals who are looking to pivot into data science from statistics-heavy roles or other industries like software engineering and academic research.

The intensive, project-based curriculum is taught by "industry-seasoned" data scientists. President and founder Jason Moss explains that hiring data scientists who can also play the role of educator can be challenging in a market where companies are also fighting for talent.

Veterans can now apply to use the Post-9/11 GI Bill to enroll at Metis, covering the cost of tuition.

What do participants need to succeed? Participants must be fully prepared with advanced-level math and statistics skills, and experience with Python and several Python libraries that enable additional scientific computing functionality. They should also understand core aspects of machine learning. Recognizing this high bar, Metis offers multiple levels of bootcamp prep courses created by the admissions and senior data science teams.

What does the organization need? To find instructors who are skilled data scientists and educators.

Senior Planet/Older Adults Technology Services

Created to help older adults use technology to achieve their goals, Senior Planet offers a range of courses from learning to operate a computer and navigate the internet to interacting online using social media.

Who is served: Older adults

Number of participants served annually: 4,000

Location: New York City

Frequency/Duration: 10 weeks, 2 times per week

Eligibility Criteria: Must be age 60 or older

Application process: N/A

Curriculum: digital literacy

Skill level: Basic

Partnerships: 200+ partners, ranging from senior centers, other nonprofits, faith-based organizations, and senior-service organizations. Including New York Public Library, AARP Foundation and the City of New York.

Cost: Free

Sources of funding: A mixture of private and public sources, including municipal agencies, corporations, philanthropic foundations, and donations

What makes this program stand out? OATS (Older Adults Technology Services) is serving the 60+ population by delivering programs that empower older adults to achieve their goals through technology. The tech programs are infused with elements of digital literacy, but ultimately oriented in different content areas so people can learn a skill based on their individual goals.

"We're a social change organization that uses tech to promote the betterment of people as they age," said Alex Glazebrook, director of operations for OATS.

OATS operates out of the Senior Planet Exploration Center in Chelsea in addition to a network of 23 public computer labs located in senior centers and faith-based organizaions across New York City.

Older adults can take classes on operating a computer, navigating the internet, and using social media. Advanced classes teach how to build websites using Wix.com and how to leverage tech platforms to build a small business.

What do participants need to succeed? To participate in programming, students must have an email address and be comfortable navigating the internet.

What does the organization need? Additional resources would help the organization reach more potential students, as the current model is cost-intensive. Glazebrook also notes that adjustments could make programming more flexible and dynamic.

FedCap Computer Service Technician Program

Workforce development agency FedCap prepares students for entry-level IT jobs including help desk and tech support

Who is served: Individuals with disabilities, adults with conviction histories, veterans, and many others facing barriers to employment

Number of participants served annually: 100

Location: Manhattan

Frequency/Duration: evenings and weekends

Application process: Entrance requirements vary by program; the application process is initiated by contacting FedCap via phone or email

Curriculum: Computer hardware assembly and repair, troubleshooting/diagnostics, basic computer networking, Microsoft Office Suite, HTML, Java

Skill level: Entry-level

Outcomes: CompTIA A+ Certification

Partnerships: FedCap's closest partner is ACCES-VR, a program of the New York State Department of Education that provides vocational rehabilitation support for individuals with disabilities. FedCap also partners with community employers who hire their graduates and host interns

Cost: Tuition costs vary, and are often sponsored by ACCES-VR and other organizations.

Sources of funding: Tuition at Fedcap Career Design School is provided by ACCES-VR and other sponsoring organizations, as well as self-pay

What makes this program stand out? FedCap is ramping up digitally oriented programming, with a focus on the fundamentals of computer hardware and software. FedCap's IT program aims to prepare students for entry level computer service technician roles, such as help desk support, as well as prepare them for CompTIA A+ certification and other certifications such as Microsoft Office certification and Cisco networking certification. Though FedCap does not currently offer a slew of digital education courses, Laura Siegel, Associate Director, Career Design School at FedCap, says they are working to develop this kind of course to meet the demand.

The program was approved to facilitate CompTIA information technology training and recently hired a new technology faculty member to round out the offerings. FedCap is looking to further develop curriculum that includes HTML, CSS, Java and other programming languages.

What do participants need to succeed? Recognizing the difficulties faced by individuals with barriers to employment such as a disability or a criminal record, FedCap works with government programs such as ACCES-VR or Workforce1 to offset out of pocket tuition costs. Post-program, FedCap offers career services for up to a year after graduation. Though the program does not formally provide bridge programming, it's something they work to integrate into their existing curriculum to aid students who need additional support.

What does the organization need? The organization needs space to offer additional programming and funding to help scale and improve services. Bridge programming would help participants improve literacy skills and better prepare them for the program, said Seigel.

"I would love to see a bridge program on the table to improve basic literacy skills," said Siegel. "Even for our folks who are coming through our custodial training program, now you need to have even just have some basic computer skills."

Sunset Spark

In addition to their programming for K–12 students, Sunset Spark works with immigrant parents to teach them how to engage their children in learning about science and technology and provides a fellowship opportunity to college students.

Who is served: Parents, immigrants

Number of participants served annually: 30

Location: Brooklyn

Frequency/Duration: Evenings and weekends

Eligibility Criteria: Generally, adults with children in schools in Sunset Park are eligible. (Adult programs are typically advertised to parents at the local schools and/or held at the schools.)

Application process: No application process

Curriculum: Creative technology

Skill level: Basic

Outcomes: Sunset Spark does not currently track outcomes for parent participants

Partnerships: Schools and local nonprofits. In the past, Sunset Spark has partnered with the Atlas:DIY, Brooklyn Public Library, Mixteca, the Green-Wood Cemetery, and NYU. They have also partnered with Industry City.

Cost: Free

Sources of funding: Service fees at schools (push-in programs during the day) and from the Siegel Family Endowment. Typically, the schools pay from their general student services budget, however in some cases they are funded through grants to the school.

What makes this program stand out? Sunset Spark works with immigrant families to make learning about science and technology fun. Courses offered include 3D printing where participants learn how to "design or scan and modify objects in 3D, then print them using 3D printers." Parents also learn about toy making and gain skills to play math games with their kids.

"We work with immigrant families because they are an

untapped resource and typically don't have access to high quality classes around science," says Sunset Spark co-founder Gaelen Hadlett.

Additional workshops include training in neurological and cognitive development for parents to learn about cognitive milestones—like the development of language and math skills—and focus on discovering scientifically-backed ways to nurture their child's growing brain. Hadlett founded the program with his wife in 2013 and they have stayed committed to their mission of providing high quality science and technology courses by mostly teaching the classes themselves.

In addition to facilitating workshops for parents, Sunset Spark also operates a fellowship program geared towards college students obtaining their bachelor's degree in computer science or mathematics, though not all fellowships are tech oriented. Fellows spend 6–9 months with Sunset Spark working on a project that aligns with their interests.

The classes are offered at no cost to families and take place in public schools and libraries across Brooklyn. Though the program primarily offers courses geared towards children, they offer workshops in Spanish and English for parents in an effort to help them learn how to use creative technology to engage with their kids.

What do participants need to succeed? Parent participants are often Spanish-, Chinese-, and Arabic-speaking immigrants, and they would benefit from more programming support in their native language. Sunset Spark works to be as accommodating as possible, and no technical experience is necessary to take part.

What does the organization need? More funding to provide high-quality programs at no cost to participants.

Nucamp

Nucamp is a hybrid program with bootcamp offerings for beginners and advanced coders.

Who is served: Adults

Number of participants served annually: 200

Location: Remote during the week; Saturday in-person workshops are held in co-working spaces throughout New York City

Frequency/Duration: 4–22 weeks, online during the week (8–14 hours) with 1 in-person Saturday workshop from 9 a.m.–1 p.m.

Eligibility Criteria: Must over 18 years of age, know how to use a computer, and be able to bring your own laptop. For advanced bootcamps, working knowledge of HTML, CSS, and Javascript is expected.

Application process: No application for beginner bootcamp in web development fundamentals; short assessment for advanced tracks

Curriculum: Web development fundamentals: HTML, CSS, and Javascript. Front End and Full Stack development teach how to build web sites and mobile apps, as well as backend database operations in the case of Full Stack. Technologies include Bootstrap, React, React Native, NodeJS, and MongoDB.

Skill level: Intro, mid-level, advanced

Outcomes: 70 percent of students graduate the course

Cost: $380-$1905

What makes this program stand out? Nucamp is an affordable and location-flexible answer to the rise in technical training programs. With tuition priced as low as $380 in New York City, Nucamp provides an opportunity for aspiring technologists to engage in coursework at a low risk when compared with immsersive bootcamps that can cost upwards of $20,000. "We want to help people who are left out of the digital economy find opportunity," said Karim El Naggar, founder and CEO of Nucamp. "We operate with a social mission."

Nucamp is a hybrid program with bootcamp offerings for beginners and advanced coders. The beginner bootcamp is a 4-week-long course teaching web development fundamentals. This course teaches the building blocks of designing for the web including HTML, CSS, and Javascript. The advanced bootcamps include a 17-week-long front-end web and mobile development course and a 22-week-long full stack web and mobile development course. These advanced courses provide the necessary skills for junior web or mobile developer positions.

What do participants need to succeed? Participants need the support of friends and family to make the 4–22 week commitment, as they are expected to spend 8–14 hours each week watching online lectures and completing homework exercises independently, without the structure of a fully on-site course.

CodePath.org

CodePath offers industry-backed, semester-long courses on campus and free of charge

Who is served: College students

Number of participants served annually: 860

Location: New York City colleges and universities (Currently: College of Staten Island, Queens College, and City College, with Columbia University in the pipeline) Baruch College and Brooklyn College have also hosted courses in the past.

Frequency/Duration: Semester-long (typically 13 weeks), 5–10 hours per week in addition to in-class time

Eligibility Criteria: For most courses, participants must be enrolled as a computer science major at a participating college or university. Some courses are suitable for non-CS majors.

Application process: Online application and assessment to determine the appropriate course level

Curriculum: Cybersecurity, Android app development, iOS app development

Skill level: Entry-level, mid-level, advanced

Outcomes: 20 percent of students with prior technical work experience obtain a more prestigious work opportunity after taking a CodePath course. 43 percent of students without prior technical work experience receive their first internship/job after taking a CodePath course. Black students who take CodePath courses are 14 times more likely than those who don't to earn tier 1 jobs or internships. Black first-generation college students who take a CodePath course are 3 times more likely to get a job at a tech company.

Partnerships: CUNY, Management Leadership for Tomorrow, United Negro College Fund, AnitaB.org. CodePath has also worked closely with Facebook for many years and regularly engage dozens of technology and corporate partners.

Cost: Free

Sources of funding: 90 percent of funding in 2018 came from earned income from corporations for recruiting.

Closer to 50 percent will come from earned revenue in 2019, with the other 50 percent coming from foundations, donors, and a small amount from colleges.

What makes this program stand out? CodePath. org started as a technical training company for senior engineers but quickly became an organization dedicated to "eliminating educational inequity in technical education" through transformational on-campus computer science education. CodePath.org—located in 49 colleges and universities across the country—provides high quality, rigorous training at scale at no cost to students.

The courses are taught directly on campus through a project-based curriculum developed with industry experts. Classes are facilitated by carefully selected and highly trained student leaders (TAs). Students access the training material, which includes video lectures and documentations, through a portal designed by CodePath. Students also have access to experts who are available to answer questions about the material. Participants attend classes once or twice a week for 2 hours in addition to independent study, which students should budget several hours each week to complete.

CodePath.org has built courses for several different subject areas including iOS and Android development, Cybersecurity, mobile app design, and technical interview preparation. Elements of computational thinking are embedded in every part of each course. Students taking these courses receive credit towards their degrees.

CodePath.org works with people at all levels in their journey, from incoming freshman thinking about pursuing a computer science degree to Ph.D students.

What do participants need to succeed? CodePath. org participants must be enrolled in a computer science course at a participating university. Some CodePath.org courses require students to have prior coding knowledge.

What does the organization need? Better connection to tech companies outside of Silicon Valley.

Recurse Center

The Recurse Center (RC) is an "educational retreat"—a project-based and self-directed school for programmers with prior coding experience looking to improve their skills.

Who is served: Adults with at least some programming experience

Number of participants served annually: 225–240

Location: Downtown Brooklyn

Frequency/Duration: 1 week, 6 weeks, or 12 weeks

Eligibility Criteria: Must have some previous coding experience and a desire to improve your skills

Application process: Written application and 2 interviews conducted by alumni

Curriculum: Self-directed by participants. RC is "not a programming bootcamp" and "not a job prep program" and is structured more like a writer's retreat.

Skill level: Advanced

Outcomes: Employment as a programmer, upskilling. While RC is not focused on job prep, it has a dedicated career services team that partners with companies looking to hire engineers and data scientists.

Partnerships: Xandr, Heap

Cost: Free

Sources of funding: Recruitment services

What makes this program stand out? Recurse Center is a community of programmers who engage in self-directed learning to refine their technical skills. RC caters to people who already love programming but have a desire to dramatically improve their skills. The program has hosted students of all experience levels, from 3 months of experience to 30 years as a professional programmer.

The program is based out of Downtown Brooklyn and organized into groups of roughly 30 people called "batches." Participants have the option to sign up for batches of 1week, 6 weeks, or 12 weeks. During that time, participants determine what they are curious about and select what they are interested in learning. The Center does not have a predetermined curriculum that focuses on specific languages or proficiencies. Instead, they encourage people to "un-school" and focus on what interests them.

What do participants need to succeed? The Recurse Center offers need-based living expense grants to women, trans people, and people from racial and ethnic groups traditionally underrepresented in programming, which grantees can then use for housing, food, childcare, or anything else needed while participating in the training. Qualified participants can request grants ranging from $500 to $7000 depending on need and duration of stay at RC.

What does the organization need? Support for students not familiar with a self-directed educational environment.

WiTNY

Launched in 2016 in collaboration with the City University of New York (CUNY), Cornell Tech, and industry partners, WiTNY is an initiative that works to propel women into tech careers through education, work experiences, and community building.

Who is served: Female-identifying students at CUNY and Cornell Tech studying computer science and related majors.

Number of participants served annually: 500

Location: CUNY and Cornell Tech campuses (Cornell Tech includes The Emma and Georgina Bloomberg Center, Tata Innovation Center, and the House at Cornell Tech.)

Frequency/Duration: Year-round

Eligibility Criteria: CUNY and Cornell Tech students with a demonstrated interest in computer science and in good academic standing. The Winternship and Career Readiness Programs require a demonstrated commitment to pursuing a career in technology, like a major in Computer Science.

Application process: A student application, potentially including free-response questions and a phone-screening

Curriculum: WiTNY's Summer Guild program teaches introductory-level coding skills in a project-based environment with the hope of sparking incoming CUNY students' interest in tech. The Winternship program is a paid internship program that runs in January and is focused on career exploration and career readiness. Students work in groups on a technical project while gaining general workplace skills and competencies. The Career Readiness program takes students through the tech-hiring process. WiTNY also hosts a series of events and initiatives to build community among its participants and also supports the design of new introductory computer science courses at CUNY.

Skill level: Intro, mid-level, advanced

Outcomes: 4,953 students have applied to participate and 1,714 students have actively participated in one or more WiTNY programs. More than 100 companies have engaged with WiTNY and CUNY students, and WiTNY has supported 14 Cornell Tech women with a fellowship. The WiTNY Winternship program has increased the percent of its CUNY women who successfully land a summer tech internship from under 5 percent to more than 50 percent. WiTNY Summer Guild participants who were not previously declared CS majors register for a course in computer science at twice the rate of their non-Summer Guild peers. Additionally, 45 percent more women have enrolled as CS majors and 94 percent more women have graduated with a CS degree.

Partnerships: Cornell Tech, CUNY, Upperline Code, and about 100 employers who volunteer for programs, host Winternship students, or hire summer internship students.

Cost: Free

Sources of funding: Corporate sponsors, including founding partners Verizon and Accenture

What makes the program stand out? WiTNY partners with 2 major academic institutions as well as industry partners. WiTNY's staff works for both these institutions and are embedded within each of them. WiTNY also has a unique and specific focus on all of their programs benefiting women, and all of their programming is geared at the specific challenges and obstacles that many women face when pursuing careers in the technology industry.

What do participants need to succeed? Students need to be ready to learn and able to commit the necessary time and work to whichever program they're enrolled in.

What does the program need? Employer partners to volunteer for programs, host Winternship students, or hire summer internship students. Additional funding for WiTNY supports more students enrolling in WiTNY's programming to keep up with student and industry demand. WiTNY is currently accepting about one third of qualified applicants into its programs.

RECOMMENDATIONS

The fast-growing technology sector represents one of the best opportunities for New Yorkers from low-income backgrounds to springboard into the middle class. But too many New Yorkers from low-income communities lack the required early exposure, hands-on skills, and educational credentials needed to compete for these jobs.

To create a tech sector that reflects the diversity of New York while greatly expanding access to economic opportunity, city leaders will need to set ambitious goals and commit to a bold and long-term agenda to expand and improve the tech skills-building ecosystem—starting with investments in the K–12 education system, where policymakers can have the greatest impact. What follows is a select group of high-priority solutions and a small number of additional recommendations for policymakers, agency leaders, education officials, workforce organizations, philanthropy, and the tech sector.

1. Make a significant new public investment in expanding and improving New York City's tech education and training ecosystem. New York City has taken some vital steps toward expanding access to technology careers, including the launch of CS4AllNYC and the Tech Talent Pipeline. But as our research shows, opportunity gaps and inequities persist in the tech skills-building ecosystem—and the city still has a long way to go. New York City should make a significant new public investment to grow and strengthen the tech skills-building ecosystem, allocating funding to expand in-school computing education to every public school beginning in kindergarten; close geographic gaps by funding and scaling in-school STEM enrichment and tech workforce training programs in underserved communities; and invest in intensive, career-aligned tech training models for working adults that lead to employment in the sector. An investment of $50 million—leveraged against additional private funding—would allow the city to strengthen crucial initiatives like CS4All and the Tech Talent Pipeline, while allocating additional resources to reach more New Yorkers with computing education programs, close geographic gaps, and scale up effective adult workforce programs.

2. Set clear and ambitious goals to greatly expand the pipeline of New Yorkers into technology careers. The mayor and City Council should create a unified set of goals and benchmarks ensuring that every student has in-school access to computational thinking and computing education beginning in kindergarten by 2025; expanding in-depth tech workforce training programs to reach at least 5,000 low-income New Yorkers annually by 2025, up from just a few hundred today; and, along with New York State, tripling the number of CUNY students who earn postsecondary STEM degrees and credentials each year by 2030.

3. Prioritize long-term investments in K–12 computing education. If city leaders do just one thing to expand access and build equity in the city's growing tech sector, our research suggests the most effective use of resources is a long-term investment in expanding and improving K–12 computing education. While New Yorkers of all ages can benefit from tech skills-building initiatives, this report finds that long-term investments in computing education are essential in order to tackle the city's persistent opportunity gap at the root. By ensuring that every student has access to effective, age-appropriate computing education—including the core concepts of computational thinking—New York City can greatly expand the pipeline into tech careers by building skills, interests, and confidence from the earliest years of a New Yorker's life.

- **Fully fund and champion the expansion of CS4All to reach every student by 2025.** The mayor and the City Council should work together to ensure that the ten-year CS4All initiative becomes a permanent pillar of the Department of Education's strategy and meets its goal of ensuring that every student at each grade level experiences at least one unit of computing education by 2025. City leaders should ensure that CS4All has the funding and institutional support needed to achieve that goal on time, and officials should hold school and department leadership accountable for successfully integrating computing education into every school and classroom.

- **Go beyond CS4All to bring computational thinking into every classroom.** The mayor, the schools chancellor, and local elected officials should build on the foundation of CS4All and further grow the city's approach to computing education. To complement the expansion of computer science classes, the Department of Education should integrate computational thinking into other

topics and classrooms, including English, social studies, art, and science. In doing so, students will gain familiarity with and fluency in computational thinking concepts and processes in ways that can better prepare students for college and careers—whether they ultimately pursue computer science, technology, creative industries, the humanities, or nearly any other field.

– **Significantly expand computing education in grades K–5.** Today, the majority of the city's K–12 tech skills-building programs are targeted toward high schools and middle schools, with too few programs reaching New Yorkers at the youngest ages. This lack of early exposure contributes to the alarming underrepresentation of Black and Latinx students and women in elective STEM programs and college majors, with consequences that can last a lifetime. To bring computational thinking and exploration of digital tools and technology to every grade and school, policymakers should focus on closing gaps in the K–5 system. The city should make computational thinking as fundamental as critical thinking in a child's intellectual and cognitive development and set a goal of greatly increasing persistence of underrepresented students in STEM throughout K–12 by starting from the very beginning.

– **Ensure that teachers at every grade level receive professional development in computing education.** Our research suggests that the most effective way to expand computing education throughout grades K–5 is to integrate it into everyday lesson plans. But in order to do so effectively, far more K–5 teachers will need access to professional development, training, and support. The city should commit new funding to ensure that far more K–12 teachers—especially those in K–5—are accessing professional development for computational thinking and STEM learning. This investment should include funding for a full-time professional development coordinator at the DOE focused on computing education, and fund the expansion of current professional development and coaching programs like Cornell Tech's Teachers in Residence initiative to dozens of new schools.

– **Launch clear statewide standards for teacher certification and require a recognized credential in computing education for all new teachers by 2025.** New York State is in the process of developing a certification for computer science teachers, but the release of guidelines has been delayed. New York State should ensure that clear guidelines for teacher certification are developed and disseminated before the end of the 2019 school year, and include clear mechanisms for educators to receive credit for prior professional development so that ongoing investments will count toward future certification. In addition, New York State is adopting new standards for computer science education beginning in December 2019, but city schools will need a larger and more consistent pipeline of trained educators to meet them. To support the development of this pipeline, the Department of Education should require a recognized credential in computing education for all new teachers by 2025—the last year of the current CS4All initiative. This requirement could help spark expanded pre-service training for aspiring teachers and create a market for designing and delivering these credentials.

4. Scale up tech training with a focus on programs that develop in-depth, career-ready skills. Although prioritizing K–12 computing education will have the greatest long-term impact on expanding access to technology careers, New York City also needs to make significant near-term investments to ensure that more working adults can train for opportunities that exist today. Seizing these opportunities will require new investments to double or triple the capacity of the specific type of programs that are in short supply today: multi-week, in-depth training programs focused on applied technical skills and real-world career readiness—and informed by specific employer needs—that consistently lead to employment, retention, wage gains, and career advancement. Today, New York City is home to a wide variety of workforce development programs and other skills-building initiatives focused on basic computer and technical skills. But relatively few free and low-cost adult training programs are focused on career-ready tech skills, and the programs that do are serving from a few dozen to a few hundred New Yorkers each year. To help more working adults access opportunities in the tech sector, policymakers should focus on scaling up the relatively small number of intensive, in-depth tech training programs that consistently lead to employment in technical occupations and provide opportunities for career advancement.

5. Build the pipeline of educators and facilitators serving both K–12 and career readiness efforts. For both K–12 schools and tech skills-building organizations focused on serving working adults, finding and developing skilled instructors poses a growing challenge. Although greatly expanding access to professional development training is one important way to stem this shortage, our research finds that the overall pipeline of trained educators is simply too small to meet the growing demand. To strengthen this pipeline, the city should fund and launch a citywide pre-service training collaborative for computing education, in partnership with local colleges and institutions. This initiative should support pre-service training to help aspiring K–12 teachers build the skills needed to integrate computational thinking into core subjects. To strengthen the instructor pipeline for workforce training programs, the Department of Small Business Services and/or the city's Economic Development Corporation should launch a training grant for technical facilitators designed to help in-depth workforce skills-building organizations prepare recent graduates and current staff to become instructors.

6. Close the geographic gaps in tech education and skills-building programs. Although New York City's tech skills-building ecosystem is larger than ever, serious geographic gaps exist across the city. It's understandable that a large concentration of programs exists in Manhattan, for reasons including proximity to employers and accessibility across multiple transit lines. But for both K–12 and adult workforce programs to reach more low-income New Yorkers, more needs to be done to place programs in communities with few, if any, options for tech skills-building today. Efforts could include grants for existing organizations to create new program locations in underserved locations and co-location of programs in community-based infrastructure like libraries and schools.

7. New York City's tech sector should play a larger role in developing, recruiting, and retaining diverse talent. New York City's growing tech sector is looking for ways to get involved in the broader skills-building ecosystem but lacks clear guidance around effective opportunities to help build and strengthen pathways for underrepresented talent. New York City's tech companies can make progress on multiple fronts: reworking hiring practices to move away from college degree requirements and toward portfolio and competency-based hiring; recruiting actively from CUNY while building relationships with college leadership and career counseling offices; expanding internship and mentorship programs in partnership with local public schools, colleges, and community-based organizations; and partnering with training organizations to inform curricula while committing to hiring their graduates. In addition, the city's tech leaders should work with existing intermediaries to develop shared infrastructure that can help small and mid-sized tech companies launch and expand internship, mentorship, and apprenticeship programs in partnership with other employers.

8. Increase access to tech apprenticeships and paid STEM internships through industry partnerships, CS4All, and the city's current Summer Youth Employment Program. Many organizations that provide STEM skills-building programs to underserved youth report that their participants are unable to find paid internship or work-based learning opportunities in STEM fields. The result is that too many young adults from low-income communities end up choosing paid work in industries like retail or food service over unpaid internships in STEM-driven occupations. The city should support the expansion of new apprenticeship programs in tech occupations, including youth apprenticeships; work with existing industry partnerships and sector-based organizations to coordinate paid internships in STEM fields; invest in CS4All to scale from 100 to 1,000 paid internships each year; and set a goal of greatly increasing the number of STEM-related jobs available through the Summer Youth Employment Program.

9. Expand efforts to market STEM programs to underrepresented students and their families. Much of the high-quality STEM programming available to young New Yorkers today is offered on a voluntary, elective, or extracurricular basis, which means that students with a preexisting interest and confidence in STEM—as well as families with more resources—tend to benefit the most, while many underrepresented students and their families just don't see STEM enrichment programs and tech careers as a viable, affordable, or welcoming option. To address this issue, the Mayor's Office should launch a multiyear campaign to raise the visibility of underrepresented people in STEM fields and market STEM programs of all kinds to both parents and children, with a focus on lower-income communities. Associated activities could include family-friendly demo days featuring women entrepreneurs and entrepreneurs of color; STEM career exploration initiatives focused on the middle-school level; intergenerational programming aimed at both parents and their children; and program outreach through public libraries, cultural institutions, parks, NYCHA developments, and other community hubs.

10. Develop and fund links from the numerous computer literacy and basic digital skills-building programs to the in-depth programs that can lead to employment. Although working adults have numerous options for acquiring basic computer skills and digital skills training, very few of these programs have connections across the broader skills-building ecosystem. To better leverage the ecosystem that already exists, New York City needs to incentivize and fund partnerships across the continuum of skills-building offerings, from basic computer skills to in-depth, career-oriented programs. For instance, new city RFPs should incentivize partnerships between libraries and other training providers focused on basic digital skills and entry-level, career-oriented training programs aligned with employer needs. These linkages can help ensure that New Yorkers have a logical next step in their skills-building pathway and support outreach efforts by career-focused training providers into low-income communities.

11. Expand the number of bridge programs to provide crucial new on-ramps to further tech education and training for New Yorkers with fundamental skills needs. Today, more than 1.1 million adults in New York City lack a high school diploma, and more than 1.8 million speak English less than very well. Due to these and other skills barriers, no matter how much the city does to grow the number of high quality, career-focused tech training programs, hundreds of thousands of New Yorkers will remain unable to access them. The city should invest at least $70 million annually in bridge programs that can serve as key on-ramps into effective education and training programs for New Yorkers with lower levels of skills and formal education.

12. Develop major new supports for the non-tuition costs of adult workforce training. For many low-income New Yorkers, the cost of attending an in-depth training program—even one with free tuition—is often prohibitive. Program managers say that too many prospective participants choose not to attend or drop out due to non-tuition financial barriers, like paying for the costs of transportation and childcare, or needing to work a full-time schedule just to make ends meet. In recent years, the city has launched important new programs aimed at offsetting some of these costs, including universal pre-kindergarten and expanded reduced-price MetroCards, but much more needs to be done. The city should work with community-based organizations and nonprofit training organizations to identify the key barriers to persistence and success, and launch targeted interventions designed to help offset some of these costs for New Yorkers who choose to pursue intensive, approved training programs—including childcare support for children under age three, MetroCards for participants in intensive tech training programs, and RFPs to support food and housing security assistance for organizations that provide in-depth tech training.

Advisory Board

ENDNOTES

1. Early Childhood STEM Working Group, "Early STEM Matters," University of Chicago, January 2017, available at http://d3lwefg3pyezlb.cloudfront.net/docs/Early_STEM_Matters_FINAL.pdf.

2. Tech:NYC and Accenture, "The New York City Tech Ecosystem Is Hiring," May 2018, available at https://www.accenture.com/us-en/insights/future-workforce/nyc-tech-jobs.

3. There is no one way to calculate the total employment in New York City's tech sector, but a 2018 estimate by Forrester Research finds 333,000 tech jobs across the New York region. Of these, at least 146,000 jobs in New York City are located in the seven industries that comprise the Federal Reserve Bank of New York's definition of the tech sector, focused on industries "in which firms use technology as their core business strategy."

4. Center for an Urban Future analysis of data from the U.S. Census American Community Survey, 2013–2017.

5. Center for an Urban Future analysis of data from the U.S. Census American Community Survey, 2013–2017.

APPENDIX

Girls Who Code partnerships:
Accenture, Adobe and the Adobe Foundation, Akamai, Amazon, American Express, AT&T, Autodesk, Bank of America, BlackRock, Blizzard Entertainment, Cadence, Citrix, Clarkston Consulting, CNA, Dolby, EA, EY, F5 Networks, Facebook, First Data, Ford Motor Company, George Lucas Family Foundation, Goldman Sachs, HSBC Bank, Intuit, Johnson & Johnson, JP Morgan Chase & Co., Kate Spade & Company Foundation, Lightspeed Venture Partners, MetLife and the MetLife Foundation, Moody's, Morgan Stanley, OVHCloud, P&G, Pfizer, Prudential Financial, PwC, RBC Capital Markets, Riot Games, Royal Bank of Canada, Software. org, State Farm, Synchrony, The Depository Trust & Clearing Corporation (DTCC), The Walt Disney Company, The Workday Foundation, Twitter, United Technologies, Viacom International, Walmart, Warner Bros., WarnerMedia, West Monroe Partners, WW International, Xandr

Code Nation program locations:
Schools: Academy of Innovative Technology, All City Leadership Secondary School, Brooklyn Emerging Leaders Academy, Brooklyn High School for Law & Technology, Brooklyn Institute of Liberal Arts, Brooklyn Preparatory High School, Cristo Rey High School, Eagle Academy for Young Men - Harlem, East Harlem Tutorial Program, Essex Street Academy, Frederick Douglas Academy II, George Westinghouse High School, High School for Dual Language and Asian Studies, High School for Hospitality Management, High School of Fashion Industries, Hudson High School, International High School at Prospect Heights, Landmark High School, Lower Manhattan Arts Academy, Lyons Community School, Manhattan International High School, Murry Bergtraum High School, Orchard Collegiate Academy, Pathways in Technology High School, Promise Academy, Queens Vocational & Technical High School, Richard Green High School, Science Skills Center High School, Uncommon Charter High School, Urban Assembly School of Design & Construction, Wadleigh Secondary School, Williamsburg Charter High School, Williamsburg High School for Art & Technology, Young Women's Leadership School

Tech Companies: American Express, Etsy, Flatiron Health, Google, Major League Baseball Advanced Media, Oscar Health, Salesforce, Schrödinger, Teachers Pay Teachers, Uber, IEX, Seatgeek, Disney Streaming Services, MoneyLion

Schools That Can: Maker Fellows program locations:
Bronx Charter School for Better Learning, Bronx Community Charter School, Bronx Lab, Concourse Village Academy, Cornerstone Academy for Social Action, Food and Finance High School, Girls Prep Middle School – Lower East Side; EPIC North High School, Harlem Academy, Hellenic Classical Charter School, High School for Excellence and Innovation, Journey Prep PS69X; MESA – Math, Engineering and Science Academy Charter High School; Mott Haven Academy; Pioneer Academy PS307Q; PS17Q; PS376K Felisa Rincon de Gautier; The Rosa Parks School PS254Q; St. Ignatius School; South Bronx Community Charter School; TALES – The Active Learning Elementary School PS244Q; Transfiguration School; Trey Whitfield School; VOICE Charter School; Washington Heights Expeditionary Learning School

BEAM partner schools:
AAMT (Academy of Applied Math & Technology/MS 343), Brooklyn Science and Engineering Academy, CCAA (City College Academy of the Arts, MS 293), CiS 303 (Leadership and Community Service Academy), Coney Island Prep, Dock Street, East Side (East Side Community High School), Excellence Boys (Excellence Boys Charter School), Fannie Lou Hamer (Fannie Lou Hamer Middle School), Girls Prep, Hamilton Grange Middle School Highbridge Green (Highbridge Green School), HVA (Harlem Village Academy Leadership Charter), Hyde (Hyde Leadership Charter School), IS 77, KIPP Infinity, KIPP STAR, M.S. 244, The New School for Leadership and The Arts, MS 118 (William W. Niles), MS 324 (Patria Mirabal), MS 358 (Queens),

PA 2 (Harlem Children's Zone Promise Academy II), PS/IS 171, PS/MS 280, PS/MS 29, SOF Brooklyn (School of the Future Brooklyn), South Bronx Early, College Academy, Sunset Park Prep, TEP (TEP Charter), The Young Women's Leadership School of Brooklyn, UA AMS (Urban Assembly School for Applied Math and Science), UAI (Urban Assembly Institute of Math and Science for Young Women/MS 527), UASCJ (Urban Assembly School for Criminal Justice), Urban Assembly Unison School, WCCS (Williamsburg Collegiate Charter School), WHEELS (Washington Heights Expeditionary Learning School)

Beam Center school locations:
Brooklyn: Brooklyn International High School, West Brooklyn Community High School, South Brooklyn Community High School, East Brooklyn Community High School, Nelson Mandela High School for Social Justice, International High School at Prospect Heights, Brooklyn School of Inquiry, M.S.442, P.S./I.S. 157 The Benjamin Franklin Health & Science Academy, M.S. 582 The Magnet School for Multimedia Technology and Urban Planning, P.S. 120, P.S. 240, P.S. 130, Urban Assembly Unison Middle School, P.S. 705, Brooklyn Frontiers. Manhattan: Manhattan International High School, Urban Assembly School for Design and Construction. Bronx: Fannie Lou Hamer Freedom High School, Bronx International High School, South Bronx International Middle School. Queens: International High School of Health Sciences, M.S. 217 Robert A. Van Wyck, I.S. 145, P.S. 62